REPORT

ON THE

DEPARTMENT

OF

SCIENCE AND AGRICULTURE

BARBADOS

FOR THE YEAR

1928-29.

ADVOCATE CO., LTD.,

Printers and Book-binders to the Government of Barbados.

1930

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No. 856.

DEPARTMENT OF AGRICULTURE,
Barbados.

6th July, 1929

Sir,

I have the honour to submit to the Board of Agriculture a Report on the work of the Department of Science and Agriculture for the year 1928-29.

I have the honour to be,

Sir,

Your most obedient servant,

C. C. SKEETE,

Acting Director of Agriculture.

Lt.-Col. The Honourable
Sir F. J. Clarke, K.C.M.G., M.C.P.,
Chairman of the Board of Agriculture.

BOARD OF AGRICULTURE,
Department of Agriculture,
July 18, 1929.

Sir,

I have the honour, by direction of the Board of Agriculture, to transmit the Report on the Department of Science and Agriculture for the financial year 1928—29.

2. I trust that it may be possible to print and publish this Report at an early date.

I have the honour to be,

Sir,

Your most obedient servant,

F. J. CLARKE,
Chairman of the Board of Agriculture.

The Honourable
The Colonial Secretary,
Public Buildings.

Table of Contents.

PAGE.

CHAPTER I.

REPORT OF THE ACTING DIRECTOR OF AGRICULTURE .. 9

CHAPTER II.

SUGAR CANE VARIETY YIELD TRIALS 18

CHAPTER III.

ECONOMIC BOTANY.

REPORT OF THE GENETICIST 27

CHAPTER IV.

AGRICULTURAL CHEMISTRY AND GOVERNMENT LABORATORY.

REPORT OF THE AGRICULTURAL CHEMIST 59

CHAPTER V.

ENTOMOLOGY.

REPORT OF THE ENTOMOLOGIST 79

CHAPTER VI.

REPORT OF THE PLANT DISEASES INSPECTOR 85

Chapters I. & II.

REPORT OF THE ACTING DIRECTOR OF AGRICULTURE.

TABLE OF CONTENTS. PAGE.

CHAPTER I.

SECTION	I.	STAFF	9
„	II.	BOARD OF AGRICULTURE.	10
„	III.	EXPENDITURE AND REVENUE ..	10
„	IV.	PLANT INTRODUCTION, DISTRIBUTION AND IDENTIFICATION	10
„	V.	NOTES ON THE SUGAR INDUSTRY ..	11
„	VI.	NOTES ON MINOR AGRICULTURAL INDUSTRIES	13
„	VII.	PEASANTS' AGRICULTURAL EXHIBITION	13
„	VIII.	EXPERIMENTAL WORK OF THE DEPARTMENT	13
„	IX.	CROP DISEASES AND PESTS. ..	15
„	X.	METEOROLOGICAL OBSERVATIONS ..	16
„	XI.	VISITORS TO THE DEPARTMENT ..	17
„	XII.	PUBLICATIONS AND LECTURES ..	17
„	XIII.	ACKNOWLEDGMENTS	17

CHAPTER II.

SUGAR CANE VARIETY YIELD TRIALS 18

Chapter I.

REPORT OF THE ACTING DIRECTOR OF AGRICULTURE.

SECTION I. STAFF.

Director of Science and Agriculture (Vacant).	C. C. Skeete. B.A. (Cantab) (acting.)
Assistant Director	C. C. Skeete, B.A. (Cantab).
Geneticist	A. E. S. McIntosh, B.Sc., Ph.D., (Edin.).
Agricultural Chemist	S. J. Saint, B.Sc., (London), A.I.C.
Assistant to Professor of Chemistry	T. A. E. Barker, B.Sc. (London).
Lecturer in Natural and Agricultural Sciences	J. H. Robinson, B.A., (Cantab).
Entomologist	R. W. E. Tucker, M.A., (Cantab). B.Ed. (Capetown).
Veterinary Officer	Lt. Col. H. Greenfield, O.B.E., M.R.C.V.S., (London).
Chief Analytical Assistant ..	C. A. Coppin, B.A. Sc. (Toronto).
Plant Diseases Inspector ..	D. R. D. Wiles, D.I.C.T.A.
Chief Clerk	H. O. Ramsey.
Second Clerk	G. D. Ramsey.
Third Clerk	C. G. Humphrey.
Fourth Clerk	Miss V. H. Roach.
First Field Assistant	Vacant.
Second Field Assistant	C. B. Foster.
Third Field Assistant	S. H. Evelyn, D.I.C.T.A
Fourth Field Assistant	J. N. W. Niccolls.
Analytical Assistant	H. A. Jones.
" "	C. St. A. Alleyne.
" "	L. A. Hall.
Botanical Assistant	C. C. Corbin.
Foreman in charge of Nurseries ..	S. A. Eastmond.

The post of Director of Science and Agriculture remained vacant throughout the year.

The Agricultural Chemist continued to take charge of the Government Laboratory and Chemical Section.

Mr. R. W. E. Tucker, M.A., (Cantab.), B.Ed., (Capetown) was appointed Entomologist and assumed duties on the 18th of July, 1928.

Lieutenant Colonel H. Greenfield, O.B.E., M.R.C.V.S. (London), was appointed Veterinary Officer and assumed duties on the 2nd of November, 1928.

Mr. T. A. E. Barker, B.Sc., (London) was appointed to the post of Assistant to the Professor of Chemistry on the 17th of November, 1928, and was seconded to the Staff of Harrison College for teaching duties.

Mr. C. O. Haynes. First Field Assistant, resigned on the 31st of July, 1928.

SECTION II. BOARD OF AGRICULTURE.

The members of the Board of Agriculture, appointed for the Legislative Session 1928-29 were as follows:—

Lt. Col. The Honourable Sir F. J. Clarke, B.A., K.C.M.G., M.C.P., Chairman.
The Honourable G. L. Pile, B.A., M.L.C.
The Honourable E. A. Hinkson, M.B.E., M.L.C.
The Honourable W. B. H. Massiah, M.A., M.D., C.M., M.L.C.,
S. C. Thorne, Esq., M.C.P.
G. C. Mahon, Esq., M.C.P.
[illegible] Pile, Esq., B.A., M.C.P.
J. D. Chandler, Esq., M.C.P.
The Director of Agriculture is an *ex officio* member of the Board.

The folowing acted on the Board during the absence from the Colony of various members of the Board:—H. A. Bovell, Esq., D. A. Clarke, Esq., Captain A. R. Fellowes, G. S. Evelyn, Esq., M.C.P., L. F. Nourse, Esq., and E. S. Robinson, Esq., M.C.P.

The Board held fifteen meetings during the year.

SECTION III. EXPENDITURE AND REVENUE.

EXPENDITURE.

Personal Emoluments	£6,714	14	2
Travelling Allowances	829	18	5
Overtime Allowance	9	0	0
Appointment Expenses of Scientific Officers	134	15	0
Expenses in Control of Sugar Cane Mosaic Disease	1,574	15	4
Expenses in Control of Pink Bollworm of Cotton (Salaries of Sub-Inspectors of Plant Diseases)	450	10	8
Experiment Stations	3,045	5	3
Government Laboratory and Sugar Cane Analytical Laboratory	1,257	4	2
Sugar Polarization Laboratory (December 16—March 31)	525	10	11
Sampling of Foodstuffs and Fertilizers	16	0	9
Initial Equipment for work of Entomologist	350	0	0
Expenses in connection with Preparation and Execution of Lease of land from Canefield and Waterford	44	8	6
	£14,951	3	2

REVENUE.

Sale of Ornamental Plants	£ 46	14	10
Sale of Produce from land leased to the Department	195	15	5
*Fees for analysis of Sugar and Molasses from December 16, 1928, to March 31, 1929 (Sugar Polarization Laboratory)	919	4	0
	£1,161	14	3

*Total amount of Fees Received and Outstanding on 15th June, 1929, £1,796. 6. 0.

SECTION IV. PLANT INTRODUCTION, DISTRIBUTION AND IDENTIFICATION.

The importation of seeds of various ornamental flowering trees and shrubs was continued during the year.

Importation of seeds and tubers of economic plants is mentioned elsewhere.

The distribution of plants during the year was as follows:—

(a)	Ornamental flowering trees ..	86
(b)	Ornamental foliage trees ..	805
(c)	Other ornamental plants	614
(d)	Fruit trees	124
(e)	Arbour Day free distribution ..	3,576

The Department undertook the organization of the distribution to plantations of sugar cane cuttings of new varieties recommended for trial.

During the course of the year the Department identified a number of plants for enquirers.

SECTION V. NOTES ON THE SUGAR CANE INDUSTRY.

The figures in the last column of the subjoined Table of Exports of Sugar and Molasses show the exports for the year 1928. The sugar cane crop of 1926-28 produced one of the largest outputs of sugar ever produced by the Colony.

The season of growth of the 1927-29 sugar cane crop was not so favourable as that for the crop of 1926-28. The young crop experienced good conditions for germination, but after January 1928 there was a severe drought which was not broken until the last week of June. Normal conditions prevailed in July and August, but the crop experienced a further set back in a dry September. A wet October and the wettest November since 1896 established a moderately heavy crop, but the cane plant was unable to respond at so late a stage in the growing period to the extent it might have done if ample moisture had been available earlier in the season. Dry conditions prevailed from the middle of December 1928 throughout the reaping season of 1929, with the result that in many districts there was a considerable decline in the yield of cane during the latter half of the season. The conditions, however, were favourable for the production of juice with abnormally high sucrose content.

The variety B.H. 10 (12) continued to occupy more than 75 per cent. of the crop in the wetter districts, whereas the variety Ba. 11569 continued to hold a similar position in the drier districts.

According to the Customs returns for the year 1928, 58,679^{10} tons of Vacuum Pan Crystals, 3,979^{14} tons of Muscovado Sugar, and 7,229,181 wine gallons of Molasses, equal at 110 gallons per puncheon to 65,720 puncheons of Molasses of all grades were exported of the total value of £1,163,938 made up as follows:—

Sugar.	Tons.	£	Value.
Dark Crystals	58,679^{10}	821,513	..
Muscovado	3,979^{14}	53,726	£875,239
	62,659^{4}		
Molasses.	Gallons.		
Fancy	6,199,477	271,227	
Choice	481,555	14,045	
Vacuum Pan	548,149	3,427	288,699
	7,229,181		£1,163,938

TABLE SHOWING EXPORTS OF SUGAR AND MOLASSES FOR THE FIVE YEARS 1923-27 COMPARED WITH EXPORTS OF SUGAR AND MOLASSES FOR THE YEAR 1928.

Sugar.	1923.	1924.	1925.	1926.	1927.	Average 1923-27.	1928.
Dark Crystal	43,497	35,640	43,561	42,990	50,221	43,182	58,679
Yellow Crystal	..	31	10	..	..	8	..
White Crystal	1	1	..	..	..	..	..
Muscovado	5,562	5,668	3,889	2,795	2,885	4,160	3,980
Actual Sugar Crop, tons ..	49,060	41,340	47,460	45,785	53,106	47,350	62,659
Molasses.							
Fancy	5,187,339	4,998,298	6,880,789	7,085,523	7,294,202	6,289,230	6,199,477
Choice	1,121,669	818,365	761,882	431,608	501,640	727,020	481,555
Vacuum Pan	50,150	170,790	208,355	243,203	462,848	227,069	548,149
Barbados	..	..	7,188	..	..	1,438	..
Special	..	..	11,121	..	..	2,224	..
Total Molasses crop, Gallons ..	6,359,158	5,987,453	7,869,275	7,760,334	8,258,690	7,246,981	7,229,181

SECTION VI. NOTES ON MINOR AGRICULTURAL INDUSTRIES.

COTTON.

Cotton was at one time the most important and extensively planted subsidiary crop, but after its cultivation was almost entirely abandoned in 1927 owing to the presence of pink bollworm, a close season for eleven months was ordered with effect from the 1st of July, 1928.

Through the courtesy of the Managements of certain selected plantations an area of cotton was grown for the purpose of maintaining a supply of seed for planting at the termination of the close season.

TOBACCO.

The area under tobacco cultivation is extremely small, and the quality of dried leaf produced inferior, but the area has been considerably extended relatively and increasing interest is being shown towards further extension and the production of a better quality of leaf.

At present the prospects of obtaining a market for manufactured leaf outside the Colony are not favourable, and production would appear to be limited to the requirements of local manufacturers.

MISCELLANEOUS.

The normal production of sweet potatoes and yams has been maintained, but the former is mainly confined to the higher districts where the West Indian sweet potato weevil (locally known as "scarabee") is rare.

The cultivation of kitchen garden crops has prospects of development under systematic and co-operative lines.

SECTION VII. PEASANTS' AGRICULTURAL EXHIBITION.

The usual Exhibition for Peasants and Elementary School children was held, with the kind permission of A. Cameron, Esq., and the Management of Blowers plantation, on December 5, 1928, at Blowers plantation, St. James.

The Exhibition was the most successful of its kind held in recent years and was well attended.

Exhibits were, on the whole, satisfactory. In several instances, there were specimens of vegetables and fruit which were as good as or better than, many of those exhibited at the bigger Show, the Annual Industrial Exhibition. A greater improvement was noted in the Poultry section than in any other section open to the Peasants.

The interest evinced in the Show every year by the school children was fully maintained. The number of exhibits of plants growing in half barrels, boxes and tins and in the vegetable section exceeded that of the previous year. The agricultural work attracted a larger number of competitors than the year before.

The award of prizes to the Headteachers for the Best Kept School Garden was made as follows:—Messrs. E. G. Smithwick, Mt. Hilloby Combined; P. W. Jones, Holy Innocents; T. O. Phillips, Southborough Boys, and L. T. Gay, Welches Combined.

His Excellency the Governor visited the Exhibition and distributed the prizes.

Mr. E. W. Alleyne, Mt. Tabor, won both first prizes for agricultural work performed by boys as well as for the largest number of prizes gained by boys in the various agricultural operations. Miss I. Bradshaw, St. Patrick's, obtained the prizes in these sections open to the girls.

SECTION VIII. EXPERIMENTAL WORK OF THE DEPARTMENT.

A. SUGAR CANE VARIETY TRIALS.

Sugar cane variety yield trials have been continued on plantations representing various districts of the Island. For the season 1927-29 the plots were laid out on a chessboard system, but for the season 1928-30 the plots have been arranged in a randomized block system. Further improvements in the technique of variety trials are being studied. An account of the results of the trials is given in Chapter II.

B. ECONOMIC BOTANY.

An account of the work of this section is given by the Geneticist in his report, Chapter III.

Sugar Cane.

The Geneticist has greatly improved the technique of cane breeding and seedling cane producton employed by this Department.

Through the courtesy of the Management of Lion Castle Plantation, the headquarters for cane arrow work were established at Lion Castle.

Sweet Potato.

A collection of locally grown varieties has been made and their characters studied. A collection of varieties, representing the most important sweet potato growing countries in the world, has been introduced. A comparison of local and imported varieties is being made by extensive yield trials; and production of new varieties, with desirable characters, by raising seedlings is being undertaken.

Tobacco.

A series of experiments in respect of tobacco varieties and culture for local conditions has been planned and the initial stages undertaken. Preliminary experiments have been conducted with controlled air curing.

Cotton.

Experiments with cotton have been continued in view of the possibility of effecting a control of the pink bollworm.

The experiments aim at producing a heavy yielding, early maturing strain, from which, in the local sense, there would be "one picking" obtained in the shortest possible time and before the crop has suffered much injury from pink bollworm infestation.

Varieties other than Sea Island Cotton are also being experimented with.

Economic Legumes.

Various legumes were introduced and experiments initiated with the aim in view of discovering from among them and those already existing in the Island a plant more suitable for green manuring purposes than Woolly Pyrol or mung bean (*Phaseolus mungo*).

Experiments were also initiated for examing the possibilities of the cultivation of Soya bean for bean production.

Miscellaneous.

Small scale field trials have been made with the cultivation of linseed for the purpose of investigating its possibilities as an oil producer.

Preliminary investigations have been made into the possibilities of the establishment of a small sisal hemp industry in the drier coastal districts of the Island.

C. CHEMICAL SECTION. GOVERNMENT LABORATORY

An account of the work of this Section is given by the Agricultural Chemist in his Report, Chapter IV.

The work begun at Sandy Lane Factory in the crop of 1928 in connexion with the Zeiss Refractometer and pan boiling was continued at Carrington Factory in the crop of 1929. The Agricultural Chemist was, as a result of the continued work, in a position to demonstrate during the season at Carrington Factory the scientific control of pan boiling by means of the Refractometer.

A series of analyses of the juice of different varieties of sugar cane were performed in order to ascertain the differential response to similar soil but different climatic conditions, the correlation between the rainfall and the amount of phosphoric acid in the juice, and the relationship between yield and the ash analyses of sugar cane juice.

Soil survey work has been initiated. The collection of data, together with results from a series of manurial trials recently initiated, will enable the Agricultural Chemist to institute a soil advisory system.

An investigation was made of the composition and feeding value of some of the green forage crops used in the Island.

In normal circumstances the Chief Analytical Assistant is in charge of the general analytical work of the Chemical Laboratory.

The usual routine analyses under the Food and Drugs Act, the Fertilizers and Feeding Stuffs Act and for various Government Departments and private individuals and firms were performed.

The Department undertook on a temporary basis the polarization of samples of sugar and molasses hitherto conducted by a private organization on behalf of the buyers and sellers of sugar and molasses. The polarization fees have proved relatively to be a considerable source of revenue to the Government.

D. ENTOMOLOGICAL SECTION.

The much needed post of Entomologist was provided for early in 1928, and the Entomologist joined the staff in July 1928.

The work of the Entomologist for the present is mainly confined to the control of sugar cane pests. Attention is also being paid to the control of pink bollworm of cotton.

The report of the Entomologist is presented in Chapter V.

E. VETERINARY SECTION.

The staff of officers provided for was completed with the arrival of the Veterinary Officer in November, 1928.

Inasmuch as the Veterinary Officer arrived late in the year under report and the greater portion of his time has been devoted to preliminary investigational work, a separate report is not now included.

The Veterinary Officer was given charge of the examination of imported animals, the care and attendance upon Government animals and the supervision of meat inspection at the Market.

During the first two months of his appointment, the attention of the Veterinary Officer was directed to the investigation of and the preparation of a report on the needs of the Island from the Veterinary standpoint.

The Veterinary Officer has emphasized the need of the organization of the Veterinary profession and work in the Island and the protection of the Veterinary Practitioners by a registration law; he has prepared schemes for stock improvement, the production of a better grade of milk, and the improvement of the system of meat inspection and distribution.

The Veterinary Officer has drafted Bills for the Registration of Veterinary Surgeons and the control of contagious diseases in animals; an Order for control and treatment of tuberculosis in cattle; bye-laws and regulations for dairies and propaganda and instructions on clean milk production.

The Veterinary Officer has investigated and made proposals in respect of contagious abortion in cattle which has caused trouble at the Mental Hospital Dairy Farm for some time and to a less extent in a few other herds in the Island. He has also made preliminary observations on a blood infection in mules.

The Veterinary Officer has instituted, with success, improvements in the feeding of Police horses.

SECTION IX. CROP DISEASES AND PESTS.

A. SUGAR CANE MOSAIC DISEASE.

Although it was found necessary during the year to proclaim additional areas as "infected areas" a general decline in the amount of mosaic disease can be claimed.

The Department maintained a staff of Inspectors throughout the greater part of the year, inspections being continued until the canes had made sufficient growth to render inspection on a large scale impracticable.

The organized distribution of healthy cane plants to applicants from within the infected areas was put into effect for the first time in the season of 1927-28, with the result that there has been a satisfactory decrease in the amount of mosaic disease in those areas. The distribution of healthy plants to planters in infected areas was repeated in the season of 1928-29.

It was found necessary to proclaim a close season for corn in the "infected areas" in order to discourage the presence of the insect vector of the disease in the proximity of cane fields.

The report of the Plant Diseases Inspector, contained in Chapter VI, provides further details and includes a financial statement relating to the work of the Department under the Mosaic Disease Eradication Act, exclusive of the salaries of Inspectors.

B. SUGAR CANE INSECT PESTS.

The cane borer (*Diatraea saccharalis*, Fabr.) and the root borer (*Diaprepes abbreviatus*, Linn.) continue to be the major sugar cane pests.

The Entomologist estimates that the former is responsible for a loss of about 20 to 25 per cent of the sugar cane crop of the Island.

An effort is being made to effect control of the pest by means of parasites.

The root borer is mainly confined to certain districts of the Island, and in those fields where infestation is most severe, it is estimated that a loss of about six to eight tons of cane an acre may be sustained.

An effort has been made to organize a systematic collection of beetles (the adults of the root borer) as a means of effecting a control of the pest.

The Entomologist has recently delivered a lecture in several districts of the Island on the major cane pests and the means of effecting their control.

C. PINK BOLLWORM OF COTTON.

The pink bollworm of cotton (*Pectinophora gossypiella*, Busck) was responsible for the voluntary cessation of the cultivation of cotton.

A close season of eleven months duration was ordered to take effect from the 1st of July, 1928, and the Department was provided with a Staff of Cotton Inspectors to make a careful search throughout the Island for wild cotton plants and enforce their destruction.

In addition to wild cotton plants, it was ascertained that okras played an important part as an alternate host for pink bollworm. Every effort was therefore made by the Inspectors to bring about the destruction of old okra plants during the dry season.

A new method of disinfection of imported cotton seed was established, namely by means of a Simon's Heater operated on a schooner or barge in the harbour. Arrangements were made for Departmental supervision of the disinfection process and for the adequate fumigation of vessels which had brought seed to the Island.

D. WEST INDIAN SWEET POTATO WEEVIL.

The West Indian sweet potato weevil (*Euscepes batatae*, Warehouse) (locally known as "scarabee") continues to be a serious pest of sweet potato in the lower districts of the Island. There has been no method yet discovered for the control of this pest. It is hoped that the discovery of a parasite of the pest will be made in the near future.

E. INSPECTION AND FUMIGATION OF PLANTS.

The usual restrictions for the prevention of the introduction of pests and diseases were enforced during the year.

Five hundred and sixty-nine consignments of plants, seeds and bulbs were inspected and it was found necessary to destroy twenty-two packages of growing plants and cuttings.

SECTION X. METEOROLOGICAL OBSERVATIONS.

A summary and the details of the meteorological observations recorded at the Meteorological Station, Codrington, appear in Appendix I., and Appendix II.

HURRICANE WARNING.

At the beginning of the hurricane season of 1928, arrangements were made whereby the Masters of ships (equipped for sending and receiving wireless messages) travelling in Eastern Caribbean waters were asked to report to the local Wireless Station of the Pacific Cable Board the occurrence of abnormal weather conditions in those waters. The Management of the Pacific Cable Board was in turn requested to transmit immediately to the Acting Director of Agriculture at Codrington House any such message received.

Arrangements were also made whereby such reports from ships, as well as reports of the existence of abnormal weather conditions at Barbados indicating the presence of a cyclonic disturbance in the Eastern Caribbean, would be communicated from the Meteorological Station at Codrington, through the Wireless Station, to Islands and ships West and North of Barbados.

The arrangements proved satisfactory and useful in the case of the severe West Indian hurricane of the 11th to 13th of September, 1928. The existence of a cyclonic disturbance centred East-North-East of Barbados was

reported to the Meteorological Station during the night of the 10th of September, and frequent messages, indicating the passage of a hurricane to the North of Barbados during the 11th of September, were issued by the Meteorological Station, thereby giving timely warning to the Leeward Islands and the Greater Antilles of the approach of the hurricane.

SECTION XI. VISITORS.

Among the visitors to the Department during the year under report were Professor T. B. Wood and Mr. F. L. Engledow, of the School of Agriculture, Cambridge University; Mr. Huxley, representing the Empire Marketing Board at the West Indian Conference; the Principal of the Imperial College of Tropical Agriculture; the Commissioner of Agriculture for the West Indies; Dr. C. W. Wardlaw, Pathologist, Banana Research Station, Trinidad; Mr. Ellsworth Huntingdon, Professor of Geography and Economics, Yale University; Professor S. F. Ashby, Imperial Bureau of Mycology, and Captain J. McN. Wingate, Department of Agriculture, Gold Coast.

SECTION XII. PUBLICATIONS AND LECTURES.

Publications issued by the Department during the year, in addition to the Annual Report for the previous year, were:—

(1) Pamphlet No. 1—Notes on the Culture of Heavy Type Tobacco.
(2) Leaflet No. 3—Notes on the Distribution of Cotton Plants and on the Provisions of the Cotton Diseases Prevention Act, 1928.
(3) Leaflet No. 4—Destruction of old Okra Plants in Connection with the Re-Establishment of the Local Cotton Industry.

A scientific paper was published by the Agricultural Chemist entitled "Pan Boiling: Its Scientific Control and the Zeiss Industrial Refractometer." (Trop. Agric. 1928 Vol. 5 pp. 279-283).

Papers read to the Agricultural Society and at public meetings were:—

(1) By the Acting Director—An outline of the Work of the Department of Agriculture.
(2) By the Agricultural Chemist—The Principles of Manuring with Special Reference to the Sugar Cane.
(3) By the Agricultural Chemist—The Scientific Control of Pan Boiling.
(4) By the Agricultural Chemist—The Feeding of Dairy Cows.
(5) By the Entomologist—The Work of the Entomological Section of the Department.
(6) By the Entomologist—The Sugar Cane Moth Borer and Root Borer and Means of Effecting their Control.

SECTION XIII. ACKNOWLEDGMENTS.

The Acting Director of Agriculture desires to record his appreciation of the assistance rendered by

(1) The Board of Agriculture throughout the year.
(2) The Management of Lion Castle plantation by granting the Department the use of land for conducting sugar cane breeding work and by facilitating the work in every way possible.
(3) The Management of Carrington Factory by permitting the Agricultural Chemist to conduct research work in Sugar Technology in Carrington Factory during the grinding season of 1929.
(4) The Management of Blowers planation by permitting the use of the factory and yard at Blowers for holding the Peasants' Agricultural Exhibition.
(5) The Management of Coverley, Lears, Sandy Lane, Warleigh and Colleton (St. Peter) by selling canes to the Department for the purpose of distributing healthy cane cuttings to areas infected with mosaic disease.
(6) The United States Department of Agriculture by supplying this Department with cuttings of sugar cane varieties passed through quarantine, by supplying insects to the Entomological Section, by supplying seeds of various economic plants.
(7) The various Departments of Agriculture and Experimental Stations referred to in the report of the Geneticist by supplying seeds and tubers of economic plants.
(8) The Botanic Station, Montserrat, by furnishing details of sanitation methods adopted in Montserrat for control of pink bollworm of cotton.

Chapter II.

SUGAR CANE VARIETY YIELD TRIALS.

Seedling sugar cane variety yield trials were conducted with plant canes and first ratoons.

The varieties in the plant cane trials (Section 1.) were divided into two groups, and each group was grown at Stations representing the wetter, intermediate and drier districts.

The plots were laid out on the "chessboard" system in the trials for the season 1927-29.

The results of the yield trials have been statistically analysed and are set forth in the following tables.

The yield in tons of canes per acre and in pounds of saccharose per acre are presented in three tables for each group representing results in the wetter, drier and all districts respectively. In the tables for all districts the varieties B.H.10 (12) and Ba.6032 are not included, because these varieties were unfortunately not included in the plots at all Stations.

The results of the ratoon trials (Section II) are taken from trials conducted in the ratooning districts only.

Following the tables dealing with the yield of cane and saccharose per acre, there are tables setting forth the average composition of the cane and juice of the several varieties tested.

A table showing the monthly rainfall at the Stations where trials were conducted is also included (Appendix III.).

SECTION I. PLANT CANES.

GROUP A

1. Wetter Districts.

(Rainfall over 75 inches from November 1927 to March 1929).

TABLE I.

Stations: Blackmans, Vaucluse, Ridgeway, Lion Castle.
Standard Error of Differences between Mean Yields of Cane = 1.89 tons per ac.
" " " " " " Saccharose = 760 lb. per acre.

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.605	36.28	B.831	13636
B.831	35.45	B.605	13012
B.381	35.36	B.891	12844
B.891	32.61	B.381	12682
B.417	32.34	B.H.10(12)	12373
Ba.11569	32.28	B.417	11799
B.H.10(12)	32.26	Ba.11569	11689
B.465	31.64	B.465	11399
B.689	29.14	B.689	10026
B.735	28.66	B.735	9625
B.693	26.09	B.693	9497
W. Trans.	24.13	W. Trans.	8084

A difference between mean yields of 3.78 tons of cane per acre or 1520 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

II. Drier Districts.

(Rainfall under 75 inches from November 1927 to March 1929.)

TABLE II.

Stations: Carrington, Hannays, Graeme Hall, Pickerings, Waterford.
Standard Error of Differences between Mean Yields of Cane = 3.2 tons per acre.
" " " " Saccharose = 251 lb. "

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.891	38.13	B.891	14002
B.605	34.95	B.831	11827
B.381	33.11	B.465	11783
B.465	32.85	B.605	11296
B.831	32.54	B.381	11136
Ba.11569	31.75	Ba.11569	11076
B.735	31.25	B.735	10225
B.417	29.30	B.417	9769
B.689	28.71	B.689	9102
Ba.6032	28.51	B.693	9041
W. Trans.	26.56	W. Trans.	8853
B.693	26.28	Ba.6032	8602

A difference between mean yields of 6.4 tons of cane per acre or 502 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

III. All Districts.

TABLE III.

Stations: Blackmans, Vaucluse, Ridgeway, Lion Castle, Carrington, Hannays, Graeme Hall, Pickerings, Waterford.
Standard Error of differences between Mean Yields of Cane=1.76 tons per acre.
" " " Saccharose = 687 lb. " "

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.891	35.68	B.891	13488
B.605	35.54	B.831	12631
B.381	34.11	B.605	12059
B.831	33.84	B.381	11823
B.465	32.32	B.465	11613
Ba.11569	31.99	Ba.11569	11349
B.417	30.65	B.417	10671
B.735	30.10	B.735	9958
B.689	28.90	B.689	9513
B.693	26.19	B.693	9244
W. Trans.	25.48	W. Trans	8601

A difference between mean yields of 3.52 tons of cane per acre or 1374 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

GROUP B.

I. Wetter Districts.

(Rainfall over 75 inches from November 1927 to March 1929).

TABLE IV.

Stations. Buckden, Mount Wilton, Lemon Arbor, Lears.
Standard Error of Differences between Mean Yields of Cane = 1.98 tons per acre
" " " Saccharose = 1709 lb. " "

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.755	33.47	B.726	12945
B.726	33.26	B.H.10(12)	11855
B.H.10(12)	31.20	Ba.11569	11480
Ba.11569	31.03	B.374	11390
B.374	30.89	B.755	11339
B.663	30.86	B.381	11019
B.391	30.61	B.391	10993
B.381	30.59	B.663	9934
B.606	28.41	B.417	9275
B.721	25.37	B.606	9194
B.417	25.01	B.721	8531
B.759	21.39	B.759	8044
W. Trans.	18.67	W. Trans.	6581

A difference between mean yields of 3.96 tons of cane per acre or 3418 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

II. Drier Districts.

(Rainfall under 75 inches from November 1927 to March 1929).

TABLE V.

Stations: Coverley, Sunbury, Sandy Lane, Warleigh.
Standard Error of Differences between Mean Yields of Cane = 1.6 tons per acre
" " " Saccharose = 999 lb. " "

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.663	31.13	B.726	11233
B.726	30.56	Ba.11569	10581
B.721	30.41	B.417	10253
B.417	30.33	B.381	10091
Ba.11569	30.20	B.759	9961
B.381	30.11	B.721	9210
B.759	29.37	B.391	8931
B.391	26.94	B.663	8930
B.606	26.92	B.755	8681
B.755	26.30	B.374	8451
Ba.6032	26.26	B.606	8170
B.374	25.25	Ba.6032	7762
W. Trans	23.41	W. Trans.	7148

A difference between mean yields of 3.2 tons of cane per acre or 1998 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

III. All Districts.

TABLE VI.

Stations: Buckden, Mount Wilton, Lemon Arbor, Lears, Coverley, Sunbury, Sandy Lane, Warleigh.
Standard Error of Differences between Mean Yields of Cane = 1.7 tons per acre
" " " Saccharose = 606 lb. " "

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.726	31.91	B.726	12089
B.663	31.60	Ba.11569	11030
Ba.11569	30.61	B.381	10555
B.381	30.35	B.755	10011
B.755	29.89	B.391	9962
B.391	28.77	B.374	9921
B.374	28.07	B.417	9764
B.721	27.87	B.663	9432
B.417	27.67	B.759	9003
B.606	27.67	B.721	8871
B.759	25.38	B.606	8682
W. Trans.	21.04	W. Trans.	6855

A difference between mean yields of 3.4 tons of cane per acre or 1212 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

SECTION II. RATOONS.

TABLE I.

Stations: Lemon Arbor, Buckden.
Standard Error of Differences between Mean Yields of Cane = 2.89 tons per acre.
" " " " Saccharose = 530 lb. per acre.

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.H.10(12)	34.60	B.H.10(12)	13094
B.472	33.51	B.472	12602
B.374	33.44	B.374	12419
B.663	33.10	B.726	11822
B.606	31.67	Ba.11569	11811
B.726	31.28	B.663	10864
B.381	29.99	B.606	10752
Ba.11569	29.88	B.381	10306
B.417	27.04	B.417	9742

A difference between mean yields of 5.78 tons cane per acre or 1060 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

TABLE II.

Stations: Blackmans, Vaucluse, Lion Castle, Ridgeway.
Standard Error of Differences between Mean Yields of Cane = 1.52 tons per acre
" " " Saccharose = 604 lb. " "

Varieties	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.H.10(12)	30.52	B.H.10(12)	11663
Ba.11569	30.25	Ba.11569	11370
B.697	28.24	B.697	9797
B.381	27.71	B.381	9683
B.689	26.27	B.689	9130
B.417	24.91	B.417	8826
B.694	20.35	B.694	7332

A difference between mean yields of 2.64 tons of cane per acre or 1208 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

TABLE III.

Stations: Blackmans, Vaucluse, Lion Castle, Ridgeway, Lemon Arbor, Buckden.
Standard Error of Differences between Mean Yields of Cane=1.6 tons per acre.
" " " " Saccharose = 597 lb. per acre.

Varieties.	Mean Yield of Cane Tons per Acre.	Varieties.	Mean Yield of Saccharose lb. per Acre.
B.H.10(12)	31.88	B.H.10(12)	12140
Ba.11569	30.13	Ba.11569	11517
B.381	28.49	B.381	9891
B.417	25.62	B.417	9132

A difference between mean yields of 3.2 tons cane per acre or 1194 lb. of saccharose per acre has a 20 to 1 chance of being a real varietal difference and can be regarded as significant with a fair degree of confidence.

SECTION III. SUMMARY OF RESULTS.

The yield trials for the season 1927-29 served the purpose of providing data from which certain varieties may definitely be eliminated and others retained for trial in future on more particular lines in order to reveal their value in the various districts and at various times of harvesting.

The trials have revealed the fact that the varieties Ba. 6032, B.417, B.689, B.693, B.721, B.735 and B.759 are inferior varieties and may be eliminated.

The varieties B. 726, B. 605, B. 891 and B. 831 can be considered at least as good as the standard varieties B.H. 10 (12) and Ba. 11569 under the climatic conditions of the season and the conditions of the experiment. The performance of these varieties merits trial in plantation observation plots.

Other varieties not eliminated will be given further trial on particular lines.

COMPOSITION OF JUICE AND CANE.

PLANT CANES

GROUP A

1. Wetter Districts.

Stations:—Blackmans, Vaucluse, Lion Castle, Ridgeway.

Variety	No. of Stations.	No. of Plots.	Per cent. by number of rotten canes.	Composition of Juice					Composition of Cane	
				Brix.	Saccharose lb. per gallon.	Saccharose per cent.	Glucose per cent.	Quotient of purity	Saccharose per cent.	Fibre per cent.
W. Trans	4	16	2·30	19·7	1·90	17·65	·66	89·4	15·33	10·01
B.H 10 (12)	4	16	1·01	21·6	2.14	19·65	·71	91·0	17·13	10·98
Ba. 11569 ...	4	16	7·43	21·0	2.09	19·25	·55	91·7	16·26	11·13
B 384 ...	4	16	2·34	20·5	2.02	18·63	·59	90·8	15·93	9·86
B. 417 ...	4	16	2·49	20·4	2·01	18·57	·53	90·9	16·19	10·75
B. 465 ...	4	16	2·72	20·7	2·01	18·59	·67	89·7	16·10	10·18
B 605 ...	4	16	2·79	21·0	2·07	19·05	·69	90·5	16·11	12·21
B. 689 ...	4	16	1·00	19·2	1·88	17·47	·42	90·8	15·31	8·10
B. 693 ...	4	16	1·51	20·8	2·08	19·21	·45	92·6	16·34	11·99
B. 735 ...	4	16	4·59	19·8	1·89	17·53	·77	88·5	15·03	11·47
B. 831 ...	4	16	·64	21·6	2·19	20·13	·36	93·1	17·13	10·17
B. 891 ...	4	16	·76	21·8	2·19	20·35	·35	93·6	17·62	10·94

COMPOSITION OF JUICE AND CANE.

PLANT CANES

GROUP A.

2. Drier Districts.

Stations:—Graeme Hall, Hannays, Carrington, Waterford, Pickerings.

Variety.	No. of Stations.	No. of Plots.	Per cent. by number of rotten canes.	Composition of Juice					Composition of Cane	
				Brix.	Saccharose lb per gallon.	Saccharose per cent	Glucose per cent.	Quotient of purity	Saccharose per cent	Fibre per cent
W. Trans	5	20	2·36	19·8	1·89	17·51	·81	88·5	14·58	12·08
Ba. 6032	5	20	1·92	18·2	1·69	15·75	·91	86·6	13·50	11·91
Ba. 11569	5	20	4·76	20·5	1·98	18·31	·96	89·5	15·48	11·07
B. 381	5	20	1·91	19·5	1·36	17·25	1·03	88·6	14·99	10·90
B. 417	5	20	4·68	19·7	1·86	17·37	·92	88·1	14·85	11·11
B. 465	5	20	2·19	20·9	2·05	18·96	·69	90·5	16·03	12·71
B. 605	5	20	3·61	19·6	1·85	17·20	1·17	87·4	14·50	12·05
B. 689	5	20	2·03	18·7	1·77	16·41	·77	87·9	14·14	10·75
B. 693	5	20	1·20	19·9	1·92	17·82	·82	89·9	15·34	11·33
B. 735	5	20	6·40	19·4	1·82	16·93	1·07	87·3	14·46	11·00
B. 831	5	20	2·46	20·9	2·05	18·93	·45	90·5	16·16	10·23
B. 891	5	20	2·15	21·0	2·09	19·27	·57	91·8	16·31	10·33

COMPOSITION OF JUICE AND CANE.

PLANT CANES

GROUP B.

1. Wetter Districts.

Stations:—Lemon Arbor, Mount Wilton, Buckden, Lears.

Variety.	No. of Stations	No. of Plots.	Per cent by Number of rotten canes.	Composition of Juice					Composition of Cane.	
				Brix.	Saccharose lb. per gallon.	Saccharose per cent.	Glucose per cent.	Quotient of purity.	Saccharose per cent.	Fibre per cent.
W. Trans ..	4	16	1·22	20·5	1·96	18·12	·53	88·4	15·64	10·24
B.H. 10 (12)	4	16	·49	21·6	2·08	19.26	·74	88·9	16·84	10·36
Ba. 11569 ..	4	16	·70	21·3	2·11	19·28	·74	89·4	16·48	11·11
B. 374 ..	4	16	·97	21·5	2·07	19·06	·74	88·7	16·30	12·10
B. 381 ..	4	16	·61	20·7	1·99	18·39	·71	88·7	15·98	11·02
B. 391 ..	4	16	2·88	21·0	2·01	18·54	·81	88·1	15·98	11·56
B. 417 ..	4	16	2·66	21·6	2·11	19·38	·59	89·6	16·49	11·28
B. 606 ..	4	16	4·59	19·8	1·83	16·97	·83	85·6	14·50	11·41
B. 663 ..	4	16	2·14	19·6	1·80	16·67	1·02	84·5	14·39	11·42
B. 721 ..	4	16	1·90	20·4	1·94	17·89	1·01	87·5	15·17	8·75
B. 726 ..	4	16	·06	22·2	2·18	20·00	·66	90·1	17·19	11·97
B. 753 ..	4	16	·75	20·0	1·84	16·99	·81	84·4	15·09	10·44
B. 759 ..	4	16	3.11	21.2	2·08	19·15	·62	90·2	16·89	10·15

COMPOSITION OF JUICE AND CANE.

PLANT CANES
GROUP B.

2. Drier Districts.

Stations:—Coverley, Sunbury, Sandy Lane, Warleigh.

Variety.	No. of Stations	No. of Plots.	Per cent by Number of rotten canes.	Composition of Juice.					Composition of Cane	
				Brix	Saccharose lb. per gallon.	Saccharose per cent.	Glucose per cent.	Quotient of purity.	Saccharose per cent	Fibre per cent.
W. Trans. ...	4	16	1·87	19·6	1·89	17·56	·76	89·5	13·70	12·03
Ba. 6032 ...	4	16	4·73	17·5	1·61	15·14	1·03	86·3	13·15	11·43
Ba. 11569 ...	4	16	4·28	20·1	1·98	18·33	·87	90·9	15·64	12·06
B. 374 ...	4	16	1·52	20·3	1·97	18·19	·91	89·7	15·00	13·16
B. 381 ...	4	16	2·14	19·7	1·90	17·66	·78	89·7	15·01	11·39
B. 391 ...	4	16	·99	20·0	1·95	18·07	·76	90·2	14·81	10·60
B. 417 ...	4	16	1·73	19·5	1·89	17·57	·77	90·0	15·09	10·57
B. 606 ...	4	16	4·06	18·2	1·67	15·57	1·14	85·5	13·62	11·54
B. 663 ...	4	16	2·82	17·8	1·64	15·29	1·31	85·9	12·85	11·40
B. 721 ...	4	16	1·94	18·9	1·76	16·38	1·81	86·6	13·56	8·92
B. 726 ...	4	16	1·04	21·4	2·14	19·70	·61	92·2	16·47	12·61
B. 755 ...	4	16	3·37	19·7	1·86	17·28	1·05	87·8	14·88	11·01
B. 759 ...	4	16	4·00	19·8	1·92	17·76	·61	98·6	15·11	10.53

Chapter III.

ECONOMIC BOTANY.

REPORT OF THE GENETICIST

FOR PERIOD FEBRUARY, 1928—MAY, 1929.

(A. E. S. Mc INTOSH, B.Sc., Ph.D.).

TABLE OF CONTENTS. **PAGE.**

SECTION I.	GENERAL INTRODUCTION	28
SECTION II.	SUGAR CANE.	
	(a) Introduction	28
	(b) Breeding	29
	(c) Seedling Selection	31
	(i) in young stages	31
	(ii) at maturity	37
	(d) Special Experiments	39
	(e) Growth Recording	41
SECTION III.	SWEET POTATO.	
	(a) Introduction	41
	(b) Varieties	42
	(c) Variety Trial	43
	(d) Seedling Work	44
SECTION IV.	TOBACCO.	
	(a) Introduction	45
	(b) Variety Yield Trial	45
	(c) Experimental	47
	(i) Spacing Experiment ..	47
	(ii) Effect of Stopping Stem Elongation on Leaf Development ..	47
	(d) Cigar Tobacco. Variety Yield Trial ..	49
SECTION V.	COTTON.	
	(a) Introduction	49
	(b) Experiments on Monopodial Production	50
	(c) Variety Yield Trial	51
SECTION VI.	EXPERIMENTS WITH VARIOUS ECONOMIC LEGUMES	54
SECTION VII.	SOYA BEANS	56
SECTION VIII.	LINSEED	57

SECTION I. INTRODUCTION.

The present uncertainty in the economic condition of the sugar industry coupled with the difficulty of producing cotton under attacks of pink bollworm, have rendered necessary a two-fold policy in field crop work. The first aims at a continued improvement in field production in both these crops in the hope of a quick return to conditions for a working profit in the sugar industry and a means of cotton pink bollworm control, while the second consists in the introduction and field trial of several possible alternative or subsidiary crops to the above, such as tobacco, linseed and soya beans. This entails work over a larger field with a resultant more diffuse information than the present writer desires, but it has been necessary in the present economic circumstances. It was impossible for one person alone to conduct the various experiments for the several crops, so that part of this devolved upon the Field Officers. The field work on cotton was superintended by the Second Field Assistant while the Third Field Assistant worked on the tobacco crop. The writer here records his appreciation of the excellent services rendered him by Mr. C. B. Foster, Second Field Assistant, in the work on cotton and sugar cane, and by Mr. S. H. Evelyn, Third Field Assistant, in the work in the tobacco experiments and in recording part of the sugar cane growth phenomena. Without the co-operation of both these officers, it would have been impossible to have carried out such an extensive programme.

The work in all crops investigated can be considered generally under several headings, viz.,

(1) the production of new varieties

(2) the trials in the field of these varieties along with established local and introduced plants in order to ascertain:—
  (a) their relative worth for promotion to standard variety grade, or
  (b) their suitability as parent plants for breeding operations.
  (See under 1).

(3) the study of the influence of various environmental factors on the development of the variety with a view to understanding the influence of these factors on its economic qualities. It is thus hoped to gain a fundamental knowledge upon which suitable field methods for a more efficient production can be established. Incidentally, it will lead to an understanding of the interaction between variety and environment and furnish information on the type of plant best suited to a particular locality; such will be a guide in the breeding of new varieties to particular areas, and

(4) work done in establishing correlations in various features in plants at similar or different ages or generations in order to be able to eliminate in young stages or to note relationships between obvious and constant features with certain hidden and more variable ones.

Examples from the above headings will appear under the report on each crop. No attempt will be made, however, to detail all the work done in each crop, since much of the information would be irrelevant to a report of this kind, while, in other cases, experiments will be repeated or prolonged for several years before making any conclusions. It is hoped to publish from time to time in departmental bulletins detailed accounts of certain investigations.

SECTION II. SUGAR CANE.

(*a*) Introduction.

The work on the sugar cane is directed towards the production of the variety or varieties which are, for the climate, soil and method of cultivation of any district, best suited to the highest production of sugar per acre. Since the soil and more especially the rainfall varies throughout the Island, it is not likely, and indeed it has been shown that one variety alone is not suited to be the best for all places; again, it is likely that no one variety can maintain a top position at any one place over the entire crop season. It is therefore obvious that a variety must be tested in order to ascertain its suitability (i) for any particular climatic (especially rainfall) and soil area, and (ii) for an early, medium or late cutting at cropping in that area.

Barbados can be conveniently divided on a rainfall basis into two:—(i) a high rainfall region where the annual precipitation averages 60 inches, and (ii) a low rainfall region, with an average of approximately 45 inches. In the former area water is seldom lacking to any extent to the plant after the start of the rains and during the growing months, although towards the end of crop season the soil may become very dry. For a normal year the variety B.H.10(12) is well suited for this region, and, so far as the plant breeder is concerned, the aim here is to produce one or more varieties giving a greater sugar per acre at any period during crop than this standard plant. Incidentally such varieties must be good ratooners. In the drier regions there is a well defined problem. Here we are dealing with a water supply which is probably frequently lower than that required by the plant for its full development. Some varieties, however, are better suited to growing under these conditions than others. Even so, however, many such varieties tend at crop time to dry out quickly. Ba.11569 is a good example of a variety which grows well but dries out rapidly as cropping progresses. On the other hand varieties, such as B.606 and Ba. 6032 are able to remain in a comparatively sound state for the crop period. In these two varieties however, the sucrose percentage in the juice is small and this lowers the sugar-per-acre figure. There is thus, it appears, an absence of a variety which alone is suited to cropping with best results in the low rainfall region, and indeed, on theoretical grounds this is highly probable. This suggests the division of the cropping season into three arbitrary periods, (i) early (ii) medium and (iii) late and breeding for varieties most suited to each period. These would then be planted in the necessary proportions and reaped in due rotation.

(*b*) Breeding.

The aim in breeding is the production of varieties most suited to particular districts for cropping in some fixed sequence.

Very little is known of the mode of inheritance of any particular character in the sugar cane. It is sufficient here to note that the exact characteristics of the parent plant or plants are not reproduced in their seedlings, but that the latter are collections of individuals differing more or less from their parents and also among themselves. It is however evident that, while being unable to predict the exact mode of distribution of the characteristics of the parents in their offsprings, it is possible to forecast general tendencies. Information on these latter has been obtained from the first year seedlings reaped in 1928 and 1929. It will be seen later that seedlings of Ba. 11569 tend to be significantly heavier than seedlings of B.H. 10(12). In the selection of parents for breeding, therefore, two features have been stressed, (i) the performance of the parent itself and (ii) its greater or less ability to hand down certain characteristics to its seedlings.

Now, the characteristics of importance are the economic ones, and it is these which are chiefly studied. Qualitative characteristics, such as colour of leaf, width of leaf, etc. are only of importance in so far as they may be related to a particular degree of development of the quantitative ones, and so, being more stable, serve as useful guides in selection.

Breeding operations were carried out at Lion Castle during November and December 1928.

The intelligent selection of parents for breeding work was handicapped by a lack of exact information on their own economic characteristics, and more especially on the nature of the distribution of the quantitative features to their seedlings.

The local standard varieties together with all plants available from importations of Java seedlings were used as parents.

Pollination was either (i) controlled or (ii) un-controlled. Control of pollination was effected by the selection of a chosen male plant and pollinating the desired female plant, with due precautions to exclude foreign pollen. This precaution was effected by the use of arrow lanterns (see Reports of the Department for 1927 and 1928) to cover the female arrow prior to emergence from its sheath until its seeds had matured.

By this system of controlled pollination both self-pollination and cross-pollination or hybridization were accomplished. Seeds from arrows which had developed and flowered openly were also collected. These were developments from fertilizations following a non-controlled pollination. It follows that self-fertilization or cross-fertilization could have taken place. Collections of

seeds from the latter type were made to supplement the seeds from controlled pollinations.

In the controlled pollination group, self-pollination was tried in three varieties. This was not done with a view to obtaining good seedlings from seed from arrows treated thus, for it is thought likely from theoretical considerations that crossing would be more suitable for this; rather was it done to find out varieties suitable for female parents. A self-sterile variety, whose self-sterility is not due to a female sterility, is one admirably adapted for controlled crossing work. Hybridization can be carried out with such plants as female parents, with a surety of the male and female parents. If, in any variety, there is even a small percentage of male fertility, and there is not self-sterility, then it is difficult or almost impossible to avoid selfing and effect a controlled cross.

In Table I is a summary of the seedling numbers derived from various parents. The number of seed germinations per box are taken as the unit for comparison between varieties, on the assumption that there is approximately an equal amount of fuzz distributed to each box at sowing.

TABLE I.

SUMMARY OF SEEDLING NUMBERS OBTAINED FROM VARIOUS PARENTS. CODRINGTON 1929. (FROM ARROWS AT LION CASTLE 1928.)

Parentage.	Total No. of boxes sown.	No. of seedlings derived.	Mean No. of seedlings per box.
A.	Controlled	Pollinations.	
(1) Selfings.			
Ba. 11569	21	9	0.43
B. 381	20	1	0.05
White Transparent ..	19	0	0.00
(2) Crossings.			
Ba. 11569 x B.H. 10 (12) ..	16	1,477	92.3
Ba. 11569 x B. 606 ..	8	182	22.8
Ba. 11569 x B. 391 ..	8	796	99.5
B. 381 x B.H. 10 (12) ..	15	51	3.4
B. 381 x B. 391 ..	8	59	7.4
W. Trans. x B.H. 10 (12) ..	4	8	2.0
P.O.J. 2364 x B. 391 ..	10	316	31.6
P.O.J. 2364 x B. 606 ..	3	15	5.0
P.O.J. 2222 x B. 606 ..	1	0	0.0
P.O.J. 2222 x B.374 ..	1	0	0.0
P.O.J. 2379 x B.H. 10 (12) ..	3	0	0.0
P.O.J. 2379 x B. 374.	3	1	0.3
B. Non-	Controlled	Pollinations.	
B. 381	21	103	5.0
White Transparent ..	10	341	34.1
B. 374	17	644	38.0
B. 891	6	1,250	208.3
B. 606	15	1,950	130.0
B. H. 10 (12)	35	283	8.1
Ba. 11569 .. .	59	4,212	71.4

Besides the actual work on pollination and collecting arrows, observations were carried out on various phenomena associated with flowering. These are summarised below. For a number of parent varieties under the different headings notes were made on the following:—

(1) The time and amount of arrowing for the varieties, White Transparent, Ba. 6032, Ba. 11569, B. 374, B.381, B. 391, B. 606, B. 663, B. 726, B. 417, B. 755 and B. 759 at Brighton, Sunbury, Warleigh and Lears and for White Transparent, Ba. 6032, B.H.10 (12), Ba. 11569, B.374, B.381, B.391, B.606, B.663, Uba, B.605, B.689, B.693, B.735 and B.891 at Lion Castle.

(2) The time for complete emergence of arrows from their sheaths with the time of first flowering and duration of flowering in each arrow for varieties Ba. 11569, B. 381, Uba, B. 606, White Transparent, B. 374, B.H. 10 (12), and B. 391 at Lion Castle.

(3) The extent of development reached by the sex organs in all parent varieties.

(4) The production of viable pollen by the anthers and of ovules by the ovaries; the tests employed being (i) microscopic observation on their structure and contents, (ii) microchemical tests with iodine, (iii) pollen grain germination tests in sugar solutions in vitro and on stylar brushes.

(5) The daily periodicity in flower opening for B. 606, B. 381 and Ba. 11569 and in anther dehiscence and pollen shedding for B. 391, B. 606, B.H. 10 (12), B. 374, Ba. 11569 and White Transparent.

The information derived under the above headings along with that summarised in Table I is necessary in outlining a breeding programme with these varieties as parents.

The results of the various observations have shown the value of Ba. 11569 and P.O.J. 2364 as female parents. This year's flower studies showed B. 891 to resemble Ba. 11569 in the development of its sex organs. Since it appears, as seen in Table I, that this variety is highly fruitful in seedling production, it is the intention to carry out controlled pollination with it during the approaching flowering season to test its fitness as a female parent. The use of B.381 and B.H. 10 (12) as female parents will be discontinued. The latter will be used as a male parent in crossing work.

(c) SEEDLING SELECTION.

(i) *In the Young Stages.*

The arrows obtained as a result of the breeding and collecting, were dried and their fuzz sown in boxes at Codrington Experimental Station. The arrangement in the field of this year's seedlings was determined by the results of experimental work in the cisterns with the 1928 seedlings. These experiments are presented here.

It was desired to know if seedlings selected in the cistern for planting in the field gave, at their first cropping, a significantly better weight than those not selected. If selection were of value in this respect, then the advantage of potting many seedlings from which to select is obvious. If no selection value resulted, then only that number required for planting out, plus a safety margin to allow for deaths, need be potted.

Selection from potted plants in the cistern was naturally delayed until the plants were about to be planted out in the field. They were then approximately four and one-half months old. Selection was made by two methods:—

(1) selection by observation

(2) an analytical selection, or selection based on actual measurement of particular features in each plant.

Selections were made within "batches" (i.e., groups of seedlings derived from the same parent or parents) and on plants of approximately the same age. In the selection by observation, the plants which appeared "best" to the selector were chosen from three hundred in any "batch." Such is probably a selection of the most vigorous seedlings in any "batch." There is not space to enter into

a theoretical discussion as to what is implied by vigour. It is sufficient that such selection can be made year after year and it is the object of the experiment to see if it is justifiable. If there is any value in selection then it is reasonable to expect seedlings selected thus to weigh heavier at reaping time than the others in similar "batches." All potted seedlings for planting out were numbered and the numbers of those selected by the above method noted.

The second method consisted in measuring various features for the same three hundred seedlings in each "batch". The following features were measured:—

(1) length of longest leaf
(2) width of " "
(3) length of pseudo-stem
(4) width " "
(5) number of tillers
(6) angle of tillers from the vertical.

Now each of these features was again measured for the same seedlings (or as many as were alive) in the field at eight months old and again at thirteen months old, at which time they had reached their greatest vegetative development.

With the data obtained, the correlation co-efficient for each feature measured for each "batch" was estimated and an idea obtained as to the relative development of each feature in the plants of each "batch" between three periods of its growth. A high co-efficient for any feature would indicate that that feature tended in any "batch" to develop proportionately in time in its three hundred constituents; that the relative extent of development of that feature in each of the three hundred plants of any one "batch" at four and one half months was similar at eight and thirteen months. If this were so then selection could be made on that particular feature at the potted stage.

This analytical method admits of tracing out the relative extent of development in time for any feature in the constituents of any "batch". It is still however to be discovered if there is any relationship between each feature and the weight and sucrose per cent. of the stool at crop time. It is obviously of no apparent advantage to discover e.g. that broad-leaved potted seedlings give broad-leaved plants at maturity, if the fact of the possession of broad leaves is not linked up with any of the valuable economic characteristics.

In all 3,380 seedlings were planted out. One hundred plants of each parent were also included. (See Table II).

TABLE II.

FIRST YEAR SEEDLINGS AT CODRINGTON. APRIL 1928.
NUMBERS PLANTED OUT UNDER IRRIGATION.

A. SEEDLINGS.

Parentage.	Number.	Parentage.	Number.
Ba. 11569*	300	Ba. 11569 x Ba. 6032 ..	300
B.H.10(12)	240	Ba. 11569 x B.H. (12) ..	300
B. 606*	300	Ba. 11569 x B. 391 ..	300
B. 374*	300	B.H.10(12) x Ba. 6032 ..	300
B. 381*	300	Ba. 6032 x B. 391 ..	300
B. 465*	340	B. 391 x B.417 ..	100
		Total	3,380

*Denotes open arrows.

B. PARENTS.—*Each* 100 *Plants.*

Ba. 11569, B.H. 10 (12), B. 606, Ba. 6032, B. 374, B. 391, B. 465, B.472. Total	800
Grand Total ..	4,180

Besides wishing to follow up the cistern selection experiments, it was desired to compare at crop time,

(1) "Batches" of seedlings
(2) Seedlings of "batches" with their own parents, and
(3) Parents, for
    (a) weight of stools, and
    (b) sucrose percentage in the juice.

In order to attempt to even up the effect of a changing soil fertility on all features which were being measured in the "batches" and parents, the entire 4,180 plants were numberd and distributed at random over the irrigated area.

In estimating the effect of selection by observation for any "batch," all selected plants had their own weight noted at crop time. Now for comparison with the remaining or non-selected plants of the "batch" each selected in the "batch" had its weight listed alongside that of the nearest non-selected plant of its own "batch." This method of pairing of selected and non-selected plants according to proximity in the field tended to eliminate soil difference effects of the entire experimental area. The results are tabulated in Table III.

TABLE III.

SUMMARY OF RESULTS OF SEEDLING SELECTION IN CISTERNS BY OBSERVATIONAL METHOD.

Parentage	No. of Pairs	Mean Weight in lb. per Stool of		Difference in Favour of Selected.
		Selected	Non-Selected	
B.606	33	31.72± 2 99	22.80± 1.97	8.93± 3.58‡
B.374	45	28.22± 2.36	25.05± 1.66	3.17± 2.89
B.381	33	33.58± 3.22	26.09± 2.54	7 49± 4.09
B.465	42	22.17± 1.99	20 43± 1.75	1.74± 2 65
Ba.11569	22	26.81± 3.29	22.87± 2.16	3.94± 3.93
B.H.10(12)	25	19.20± 2.12	17.80± 2.32	1.40± 3.14
Ba.11569 x B.H.10(12)	18	36.22± 3.99	24.83± 2.72	11.39± 4.82‡
Ba.11569 x B.391	20	28.10± 2.74	23.20± 3.06	4.90± 4.10
B.H.10(12) x Ba.6032	20	21.10± 2.16	17.60± 2.64	3.50± 3.42
Ba.11569 x Ba.6032	16	30.20± 4.09	26 30± 3.27	3.90± 5.24

‡These differences are statistically significant.

Treating the means of the selected and non-selected in each "batch" as comparable pairs we can employ Students' method of estimating the mean difference and its significance in favour of the selected over the non-selected for all "batches." The following is the result:—

Difference in Favour of Selected over Non-Selected for all "Batches."

5.04 lb ± 0.97

This difference is highly significant.

There thus appears to be a value in selection in the cistern by the method of observation in that the selected seedlings at crop time are significantly heavier than the non-selected. Whether this is a temporary gain or one which lasts over succeeding crop years is now being tested by a system of correlating yields in seedling populations in successive crop seasons.

A summary of the results obtained in the second or analytical method of selection is given in Table IV.

No attempt has been made in this respect to give any discussion on or definition of or justification for, the selection of the features correlated. It is hoped to detail the entire experiment in a departmental bulletin and it must suffice here to give the results only.

TABLE IV.

FIRST YEAR SEEDLINGS AT CODRINGTON 1927—29.

CORRELATION COEFFICIENTS FOR SEVERAL FEATURES IN SEEDLING "BATCHES" AT THREE STAGES IN THEIR GROWTH

I. LENGTH OF LONGEST LEAF.

Stages (Months Old.)

Parentage	*Four and One Half and Eight*			*Four and One Half and Thirteen*			*Eight and Thirteen*		
	Number Measured	Correlation Coeff	Probability (P)	Number Measured	Correlation Coeff.	Probability (P)	Number Measured	Correlation Coeff.	Probability (P)
Ba. 11569	300	+.123 ±.057	...	281	+.331 ±.054	> .01	280	+.202 ±.057	> .01
B.H. 10 12)	200	+.229 ±.067	> .01	202	+.142 ±.069	c .05	183	+.237 ±.070	> .01
Ba. 11569 x B.H.10(12) ..	289	+.183 ±.057	> .01	284	+.138 ±.058	c .02	278	+.132 ±.059	> .02
B. 606	290	+.176 ±.056	> .01	275	+.167 ±.058	> .01	268	+.219 ±.057	> .01
B. 465	274	+.190 ±.058	> .01	245	+.084 ±.063	c .20	264	+.182 ±.059	> .01

II. WIDTH OF LONGEST LEAF.

Ba. 11569	300	+.412 ±.048	> .01	281	+.153 ±.058	> .01	280	+.372 ±.052	> .01
B.H. 10(12	200	+.326 ±.063	> .01	203	+.161 ±.069	> .01	182	+.367 ±.064	> .01
Ba. 11569 x B.H. 10 (12) ...	289	+.284 ±.054	> .01	284	+.065 ±.059	c .30	247	+.454 ±.051	> .01
B 606	290	+.300 ±.058	> .01	275	+.021 ±.060	c .70	266	+.292 ±.056	> .01
B. 465	313	+.390 ±.052	> .01	280	+.377 ±.051	> .01	264	+.275 ±.057	> .01

TABLE IV.—*Continued.*

III. LENGTH OF PSEUDO-STEM.

Stages (Months Old.)

Parentage	*Four and One Half and Eight*			*Four and One Half and Thirteen*			*Eight and Thirteen*		
	Number Measured.	Correlation Coeff.	Probability (P)	Number Measured	Correlation Coeff.	Probability (P)	Number Measured	Correlation Coeff.	Probability (P)
Ba. 11569	300	+.119 ±.057	c.05	282	+.026 ±.059	c.70	279	+.414 ±.050	>.01
B. H. 10 (12)	210	+.486 ±.053	>.01	203	+.266 ±.065	>.01	178	+.614 ±.047	>.01
Ba. 11569 x B. H. 10 (12) ...	287	+.329 ±.053	>.01	284	+.232 ±.056	>.01	275	+.501 ±.045	>.01
B. 606	290	+.223 ±.055	>.01	275	+.148 ±.050	>.01	267	+.551 ±.043	>.01
B. 465	287	+.363 ±.051	>.01	279	+.068 ±.059	c.30	251	+.183 ±.061	>.01
IV. WIDTH OF PSEUDO-STEM.									
Ba. 11569 ...	300	+.025 ±.059	c.70	282	+.018 ±.059	c.80	278	+.161 ±.058	>.01
B.H. 10 (12) ..	200	+.275 ±.065	>.01	203	+.079 ±.069	c.30	172	+.127 ±.075	c.10
Ba. 11569 x B.H. 10 (12) ...	289	+.294 ±.053	>.01	284	+.021 ±.059	c.70	275	+.124 ±.059	c.02
B. 606 ...	274	+.163 ±.058	>.01	274	+.013 ±.061	c.80	268	+.143 ±.060	c.02
B. 465 ...	298	+.202 ±.055	>.01	279	+.042 ±.059	c.50	252	+.063 ±.063	c.03
V. NUMBER OF TILLERS.									
Ba. 11569 ..	300	+.405 ±.048	>.01	176	+.292 ±.069	>.01	175	+.519 ±.055	>.01
B.H. 10 (12) ...	240	+.380 ±.055	>.01	121	+.328 ±.081	>.01	112	+.539 ±.067	>.01
Ba. 11569 x B.H. 10 (12) ..	289	+.460 ±.046	>.01	174	+.216 ±.072	>.01	173	+.389 ±.065	>.01
B. 606 ...	290	+.308 ±.053	>.01	188	+.234 ±.075	>.01	153	+.412 ±.065	>.01
B. 465 ...	323	+.470 ±.043	>.01	220	+.257 ±.063	>.01	211	+.525 ±.050	>.01

TABLE IV.—(*Concluded*).

VI. ANGLE OF TILLERS FROM THE VERTICAL.

Parentage	Number Measured	Stages (Months Old). Four and One Half and Eight.	
		Correlation Coefficient	Probability (P)
B.H.10(12)	110	− .029± .095	c.80
Ba.11569 x B.H.10(12)	261	+ .233± .058	> .01
B.606	289	+ .182± .056	> .01
B.465	229	+ .162± .064	c.30

(Note. A positive correlation co-efficient indicates that, for any feature measured the relative extent of its development in individuals at any period tends to be more or less similar to the relative extent of development at another period. A positive correlation of +1.000 shows that the relationships at the two periods are similar. Any co-efficient figure between +0.500 and +1.000 can be said to reveal strong positive relationships or correlation; co-efficients between +0.250 and +0.500 reveal weak correlations while co-efficients of +0.001 to +0.250 reveal little or only very weak correlations. A negative correlation co-efficient shows that the relationships between the measured features at any two periods tend to be reversed, to a degree, greater or less according as the co-efficient varies from—1.000 to —0.001.)

The most striking fact in the summary of the correlation co-efficients over all features measured is that, while none, except perhaps those of tiller number, are high, all, with a few exceptions, give weak positive correlations. This indicates that for all features there is a slight tendency for the relationships to remain similar at different stages.

For a selection at the potted stage, i.e., four and one half months old, the coefficient values indicate that the only feature of any value, and incidentally a small value, would be tiller number. No great advantage would appear to be gained by selecting on the other features measured in this experiment.

Since there is a weak positive correlation between tiller number at four and one half and thirteen months, and as it has been proved from other experiments that tiller number is positively correlated with stool weight, then the success of the "observation" method of selection in the cistern is in part accounted for, since the selector tends to choose plants of a high tiller number.

It is quite conceivable that some at least of the other measured features, as detailed above (q.v. page 32) are corelated at reaping with high stool weight and this adds further explanation for the success of the "observation" method, since such features as wide leaves, long leaves, long pseudo-stems, etc. do attract the attention of the observer.

The 1928-30 first year seedlings have been put out this year in a manner suited to verify the above results for the 'observation' method in the 1927-29 group.

The 1927-29 seedlings were divided into three equal lots and each lot reaped at a different period during the crop season.

The weights recorded by the parent stools were found to be far below the usual obtained in variety trials, owing probably to the short growing period. Only the sucrose percentages of those seedlings chosen in the field were obtained, to serve as further information in a subsequent more severe elimination. As a result, for any parent, no reliable information on the mode of inheritance of the percentage of sucrose in the juice of its seedlings could be obtained owing to the smallness of the number analysed.

In Table V is a summary of the weight of the stools produced by the different "batches."

TABLE V.

FIRST YEAR SEEDLINGS (1927-29), REAPED AT CODRINGTON DURING CROP SEASON 1929.

Parentage	No. of Seedlings.	Mean Weight Per Stool (lb.)
Ba.11569	155	30.10± 1.34
Ba.11569 x B.H.10(12)	173	28.64± 1.18
B.374	137	28.00± 1.14
B.606	153	26.60± 1.18
Ba.11569 x Ba.6032	186	25.83± 1.15
B.381	202	24.46± 0.93
Ba.11569 x B.391	113	22.83± 1.30
B.465	227	20.77± 0.83
B.H.10(12)	113	18.94± 1.10

Since neither B.465 nor B.H. 10 (12) gives seedlings which show a consistently higher sucrose figure than seedlings from the other parentages shown, their use as female parents in breeding will be discontinued.

(ii) *Selection at Maturity.*

It would be well at this point to consider the new scheme of seedling selection and trials which is now to be carried out in order to test the seedlings against the standard varieties now grown. As previously stated the aim is to obtain the variety or varieties best suited to any district. Now, water supply is the all important factor so far as district is concerned. In any district also, since the crop time extends over a period of about five months, its duration can be divided into several periods, and the variety best suited to a period determined.

The divisions are made thus:—

District.	*Crop Period.*
High rainfall.	Early.
	Medium.
	Late.
Low rainfall.	Early.
	Medium.
	Late.

Lemon Arbor can be taken as an example of a high rainfall station, while Dodds represents an estate with a low rainfall. Now, in a selection of 1st year seedlings at crop time at Codrington, the entire block of seedlings is divided into three lots which are reaped thus:—

Lot.	*Name.*	*Time of Reaping.*
1st.	Early	End of January.
2nd	Medium	Middle of March.
3rd	Late	End of May.

Twenty seedlings are finally selected in each lot, making in all sixty. Now, these are planted under irrigation at Codrington immediately after their selection, so that when the planting season in November arrives, sufficient setts may be obtained from each seedling to allow of its being planted at the above stations in plots sufficiently large and replicated that reliable statistical information as to its worth, when compared with the standard varieties, can be obtained for the climatic conditions obtaining in that year. At each station each seedling will be retained in its original lot and compared with the local variety or varieties known to be best for that period for which its lot was selected, and each lot will be cut at the period for which it was chosen. A repetition of this lay out for three years at most should decide if any seedling is better than the standard check plants of its own lot at either station.

At present, in the first year seedling lay out, the selection in the cistern of "batches" of seedlings for each lot corresponding to a period at cropping, is made rather blindly, but with increasing knowledge of the characteristics handed down to seedlings by various parents, this selection will be made much more intelligently.

In each lot of the first year seedlings the selection is made as a result of information accumulated for each seedling from various sources, viz., (a) field, (b) factory, and (c) at the Experimental Station. Twenty seedlings are desired from each lot and for this about two thousand are cut. Approximately one hundred seedlings are selected in the field on the following features of the stools of each:—

(1) weight
(2) habit
(3) length and width of the canes and weight of each
(4) number of rotten canes
(5) amount of trash
(6) cleanliness in trashing
(7) freedom from arrowing, and for the last lot
(8) freedom from drying out.

Each seedling selected in the field has its canes divided into two approximately equal bundles. One bundle is sent to the mill, while the other is retained at Codrington Experimental Station. From that lot sent to the mill is determined for the seedling

(9) percentage sucrose in the juice.

To the information derived under the above headings are added, for each seedling, features of its canes seen in the other half of its stool at Codrington. These are

(10) node and internode features
(11) the buds
(12) freedom from rooting, and
(13) nature of the pith.

The final selection of the twenty is then made. Naturally the greatest importance is attached to the sucrose percentage in the juice, weight and habit of the stool.

In order to see if the use of these features for selection is justified, various experiments were made with groups of seedlings. Cuttings of first year seedling plants were planted in 1928 and reaped in 1929. The use of any feature as a basis for selection in first year plants is not justifiable until it is proved by experiment that, for any group of seedlings, the relative worth of its individuals remains fairly much the same from year to year. For example, it is desirable that seedlings giving high sucrose percentages or high weights should repeat the performance in following years, else there is no reason for using the figures for these features in the first year as bases for selection. The extent of the relationship is established by determining correlation coefficients.

The weights and sucrose percentages of the second year were, for each seedling, the means of six plots, and in each plot the seedlings were randomized. There were four stools of each seedling in each plot.

TABLE VI.

CORRELATION COEFFICIENTS ESTABLISHED BY EXPERIMENTS FOR THE FEATURES, WEIGHT OF STOOL AND PERCENTAGE SUCROSE IN THE JUICE, FOR SEEDLINGS IN THEIR FIRST AND SECOND YEAR.

Correlation.	Reaping Years as 1st and 2nd year seedlings.	No. of Seedlings.	Correlation Coefficient.	Probability (P)
Sucrose percentage in Juice	1928 and 1929	43	0.6218	.01
Weight	1928 and 1929	19	0.8371	.01

These coefficients are high and denote the value of sucrose per cent. and weight as selective features in first year plants. It must be admitted that, on theoretical considerations, the coefficient for weight is astonishingly high. A larger number of first year seedlings with great ranges in weight are being put out this November for a further proof of this result.

By the new scheme of seedling testing outlined above it will be possible to determine correlation coefficients for the quantitative features in sixty seedlings between each year of their cropping. The degree of retention of the qualitative characteristics can also be followed.

The information derived will enable one to estimate just how much relative importance can be put in the various features used in first year selection. (q.v. page 38).

(*d*) SPECIAL EXPERIMENTS.

Experiments other than those directly concerned with breeding and selection of new seedlings, were carried out. All were so planned, however, as to give information which could be used in breeding and selection. At the same time they reveal possibilities for improved methods of cultivation and manuring.

The percentage of sucrose in the juice is of great importance in the yield of sugar per acre. It is necessary, therefore, to note how this figure varies, what are the factors influencing this fluctuation and the relative importance of such factors. The following influential factors were studied, (a) variety, (b) age of cane, and (c) time of reaping. These factors may act independently or they may influence one another in their effect on the sucrose percentage in the juice.

Two experiments were performed. (1) at Codrington Experimental Station, and (2) at Brighton, St. George. At the former station the effect of (a) variety, and (b) time of reaping on the sucrose percentage and the interaction between these were determined. In all, twenty second year seedlings of Ba. 11569 were grown and sucrose percentage determinations were made at four times during the crop season of 1929, viz. (1) in the middle of January, (2) 1st week in March, (3) 2nd week in April, and (4) 3rd week in May. All varieties (seedlings) were replicated six times and in each replication the varieties were placed at random. At each sampling time representative samples of six canes each were taken from each replicate of all varieties and the sucrose percentage determined. Replication allowed of the exclusion of any variability in sucrose percentage between varieties or times which was due to difference in position in the field, (a soil effect). In Table VII which follows, the sucrose percentages for all varieties for all reaping times are given. For economy in space the sampling figures have been omitted and only the mean of the six samples for each variety at any time given.

TABLE VII.

THE EFFECT OF (1) VARIETY AND (2) TIME OF REAPING ON THE PERCENTAGE SUCROSE IN CANE VARIETIES, AND THE INTERACTION BETWEEN THESE CAUSES.

Percentage of Sucrose.

Variety	Time of Reaping.				Mean of each variety for all reapings.	
	1	2	3	4		
Ba. 11569	13.09*	18.19	19.45	18.69	17.28	
B(28)20	10.83	15.62	17.89	18.15	15.62	
B(28)21	10.92	16.69	18.05	17.59	15.81	Significant difference between variety means for all reapings equals 0.58% sucrose.
B(28)22	9.32	14.72	17.78	16.68	14.21	
B(28)23	15.20	19.25	20.39	19.93	18.65	
B(28)24	13.30	18.09	19.80	18.95	17.54	
B(28)25	11.09	17.15	18.24	17.79	16.07	
B(28)26	9.66	14.95	17.42	18.69	15.18	
B(28)27	12.41	18.36	18.39	19.76	17.18	
B(28)28	12.72	16.99	18.21	19.04	16.74	
B(28)29	11.54	16.54	19.15	17.48	15.72	
B(28)30	10.98	14.94	17.65	16.39	14.99	Significant difference between sample means equal 1.16% sucrose.
B(28)31	12.26	16.92	18.49	17.55	16.31	
B(28)32	9.13	14.52	15.75	17.47	14.18	
B(28)33	11.91	16.99	17.57	19.30	16.44	
B(28)34	10.95	14.82	15.47	15.61	14.17	
B(28)35	13.71	17.83	18.86	19.60	17.50	
B(28)36	14.09	17.50	18.05	17.32	16.73	
B(28)37	12.21	16.32	17.42	17.73	15.92	
B(28)38	11.68	16.01	17.49	18.32	15.87	
Means of all varieties at reaping.	11.85	16.62	18.08	18.10	16.11	

Significant difference between any two reaping means for all varieties equals 0.26% sucrose.

*Each figure is the mean of determinations for six samples. (one from each six plots).

The results have been analysed statistically in two stages, (for method see E. J. Maskell in Tropical Agriculture VI, No. 2, page 46). A "treatment" here is the effect of any one variety at one time on the sucrose percentage. The lowness of the effect of soil on sucrose percentage as revealed by the relatively small mean square of the blocks, admitted of this treatment for the lay out employed.

Stage I. Variance.	Degrees of Freedom.	Sum of Squares	Mean Square
Total	479	4354.528	9.0909
Between "treatments"	79	3953.694	50.0468
" blocks	5	3.040	0.6080
Random	395	397.794	1.0070

Stage II. Variance.	Degrees of Freedom.	Sum of Squares	Mean Square
Between "treatments"	79	3953.694	50.0468
Variety	19	663.384	34.9149
Reapings	3	3149.880	1049.9600
Interaction between variety and reapings	57	140.430	2.4637

There was a significant rise in the mean sucrose percentage of all varieties in the second and third reapings over the first. The mean figure for the third reaping was significantly greater than the second by 1.46 per cent sucrose, but there was not a significant difference between the means of the third and fourth reapings. The point of importance, however, is that all the sucrose percentages in all varieties do not react relatively similarly to time. For example, between the third and fourth reapings B(28)30 drops by 1.26% in its sample sucrose percentage while B(28)32 increases by 1.72%. There is a differential response of the twenty varieties in the experiment in the sucrose per cent. of their samples in successive reaping stages. Statiscally the significance of this differential response in the sucrose per cent of the varieties in time can be estimated by comparing the mean square value obtained for interaction in Stage II and comparing it with the random mean square value in Stage I. This gives us a value for 'Z' 0.4472*, which shows that there is a highly significant differential response of the sucrose per cent of the twenty varieties over the four reaping times.

From this experiment the point of importance to the plant breeder is that varieties differ in the times of optimum sucrose per cent in their juice during crop season. Some may be at their best at one period while others attain the maximum sucrose per cent in their juice at another period. As a result the relative positions of the varieties vary between different cropping periods, so that a variety which is e.g., third at first cropping may drop to eleventh at the last cropping. These results go to justify the new scheme of seedling selection. (q. v. page 37).

A feature of interest is the small contribution of the difference in soil (blocks) to the total variance, showing that in this experiment, the soil did not contribute to any extent to the differences in sucrose per cent from the general mean.

The other experiment was planted at Brighton to test the effect of (a) age of cane in the stool and (b) time of reaping on the sucrose per cent. in the juice of the cane; also, the differential effect on sucrose per cent., if any, of age of cane and time of reaping. Four varieties, viz.: Ba. 11569, B.417, Ba.6032 and B.726 were used. There were four plots of each and in each plot seven or eight stools were used, such that, for each variety, thirty stools in all were employed. In each stool in August, 1928, markings were made of shoots (canes) of different ages, viz.: (1) old ((2) medium and ((3) young; for convenience, called a, b and c shoots respectively. At crop time thirty samples of each cane type (a, b or c) of each variety, proportionately supplied by each of the four plots, were cut, milled and their sucrose percentages determined. This was repeated four times during crop season. The results are to hand but have not yet been analysed statistically. A summary will be held over until the next report.

(*e*) GROWTH RECORDING.

Numerous growth records on seedlings and standard varieties have been made during 1928 and 1929. The method employed in this study is to note growth change by recording the change in length of cane and number of shoots in time in different varieties so as to note the effect of the factors, such as: (a) variety, (b) soil moisture, (c) rainfall, (d) temperature of air and soil, on such changes. Already interesting data has been accumulated, but will be held over to give time for further recording.

SECTION III. SWEET POTATO.

(*a*) INTRODUCTION.

The distribution, extent and time of sweet potato growing in Barbados is largely determined by the West Indian sweet potato weevil (*Euscepes batatae*, Watehouse), locally known as the scarabee beetle. From the plant breeder's point of view it appears necessary, in order to get rid of this interference, to produce a potato which is not at all or only slightly attacked by this insect. Now, it is not thought likely that immunity can be obtained through an actual mechanical resistance of the plant to attack, nor through the variety being distasteful to the parasite. It seems, however, that a quick growing and maturing variety can escape severe attacks, if it is lifted whenever mature and not allow-

*when $n^1 = 57$; $n^2 = 395$ 5% value of 'Z' = 0.1644.
1% „ „ „ = 0.2352.

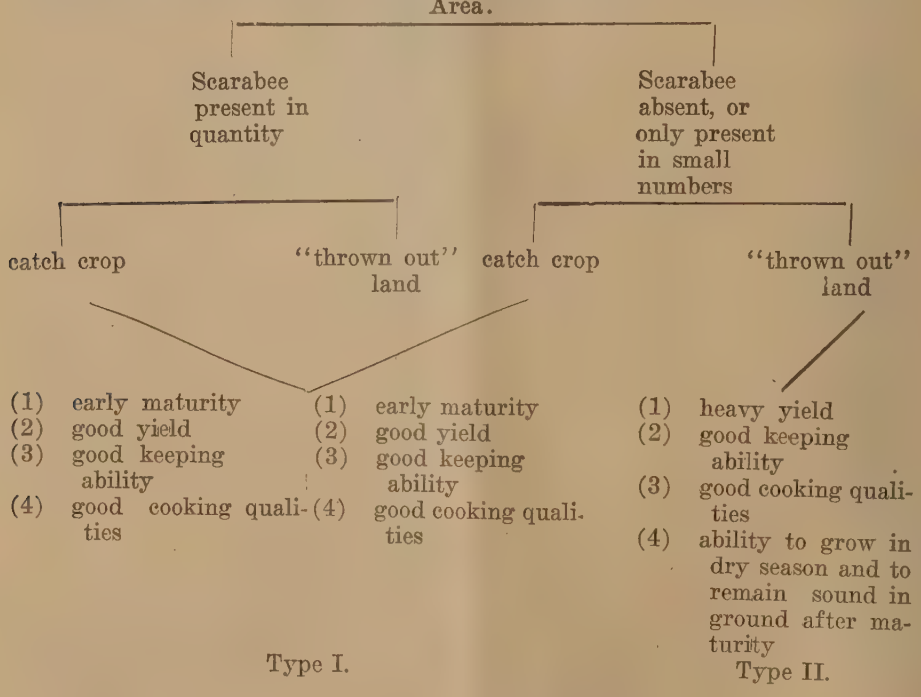
ed to be in the ground for any length of time. Hence, for this reason, alone, there is a premium on early maturity in scarabee infested regions.

Early maturity is also desirable for short growing seasons. There are roughly two seasons for growing sweet potato and these may overlap. These may be called (a) short and (b) long seasons. The short growing season is the time between planting in July or early August after the land has borne a crop of sugar cane, and lifting in November. Here the sweet potato is a catch crop. The growing season is short—approximately fourteen weeks. The other or long season allows of growth over a longer period. This cropping time is only possible in "thrown out" land. Generally, planting is done from August until about October to give a succession of harvests during the dry season. The potatoes occupy the ground for approximately twenty-two weeks, but this time may vary considerably.

The extent of the damage of a scarabee attack at any place appears to be in proportion to the number of insects present. In districts where the insect occurs, it seems to be impossible to avoid it in a long crop period. Where the insect does not occur, it appears that quick maturity, with its probable association with lighter weight and lower keeping quality, is not a necessity, but that a slower growing, heavier yielding and better keeping variety should be produced from such scarabee-free areas. For scarabee infested districts, it appears advisable to grow only quick maturing types at all times. The chances of getting good sweet potato crops late on in the dry season in scarabee-infested regions appear to be remote, and production for such time were perhaps better left to the scarabee-free areas. In the latter areas a considerable amount of growth would have to be made by potatoes which mature about the end of the dry season, during the dry season, and thus appears the necessity of breeding for ability to grow at this time.

Good keeping and cooking qualities are necessary at all times.

The conditions in Barbados appear, therefore, to demand a breeding of two distinct types of potato. This is shown in diagrammatic form below.



(*b*) SWEET POTATO VARIETIES.

The writer made a collection of those varieties grown on a crop scale in the Island. To these were added various varieties grown on a small scale in gardens or occurring as seedling "rogues" in sweet potato crops. Apparently similar field varieties had different names in different places and botanical studies had to be made in order to determine the validity or otherwise of such name distinctions. It was soon apparent that many names were given to the same variety. Incidentally, this seems to the writer to be a bad custom, for it appears to indicate indifference to varietal importance and performance, with the result that

almost any variety is considered suitable for any place for any length of growing season. An example of the danger of this will be shown later. The variety should have one name only and that name ought to stand for particular economic features which belong to the variety bearing it; only then will it be possible for the planter to select his variety intelligently for his own particular requirements.

The Department sent for the outstanding varieties grown in Queensland, Australia, Hawaii, Philippine Islands, Porto Rico, New Jersey, U.S.A., St. Vincent, St. Croix. These countries possessed either old established varieties, or comparatively new ones derived through seedling raising and selection.

As with the sugar cane, so with the sweet potato is it impossible to select parents in breeding work since so little is known of their own capabilities and certainly nothing as to the economic features in their progenies. No large scale effort in controlled crossing will be made until more is known about the parents and their offsprings.

In order to gain this knowledge a large field trial is to be put out shortly with all the parent varieties on hand. These will be tested as (1) short season (fourteen weeks) and (2) long season (twenty-two weeks), plants. The features to be tested are (1) yield, (2) keeping quality, (3) cooking quality, (4) size and shape of tubers, and (5) habit, such as amount and distribution of haulm and point of origin of tubers.

The varieties to be tested with the place where they were obtained are listed below:—

Variety.	Place of Origin	Variety.	Place of Origin.
Six Weeks	Barbados	Orange Hill	Barbados
Trinidadian	"	White Sealy	"
Red Nut	"	Freshwater	"
Bequia	"	Bourbon	"
St. Joseph Water Hole	"	Brook's Gem	Australia
Caroline Lea	"	" Seedling	No. 6 "
Hall's Seedling No. 1.	"	" "	No. 29 "
" " No. 2.	"	" "	No. 6 "
Purple Stemmed Six Weeks	"	" "	No. 3 "
Todd	St. Kitts Nevis	V 52	St. Vincent U.S.A.
Hug-me-Tight	"	Southern Queen	"
White Gilkes	Barbados	Pumpkin Yam	"
German	"	Yellow Jersey	"
		Nancy Hall	"

(*c*) VARIETY TRIAL.

During the rainy season of 1928, experiments were performed with the Barbados varieties. Twelve varieties were used for a yield trial and to serve as sources of seed for seedling work. All the varieties were planted in five plots. Four of these plots were used in the yield experiment, while from the fifth, sweet potato seeds were collected. Since the varieties in the fifth plot grew close to one another and bees were seen to visit the flowers in great numbers, it is possible that crossing might have taken place and many of the seeds be of hybrid origin.

All varieties were distributed at random in each of the four yield plots. There were fourteen holes of each variety in each plot, the holes being five feet by two and one half feet. There was a space of five feet between the holes of the different varieties in each plot. The slips were put in on the 12th of September, 1928, and all yield plots were harvested on the 20th of December. There was therefore a growing season of one hundred days, or roughly, fourteen weeks. This served as a good catch crop test.

The yield for each variety is expressed below in Table I as the mean yield in pounds for a single plot of fourteen holes:—

TABLE I.

SWEET POTATO CATCH CROP—YIELD TRIAL—CODRINGTON 1928.

Variety.	*Yield in lb. 14 Holes*
Caroline Lea	28.50
Bequia	28.25
Six Weeks	25.88
Red Nut	24.25
Vincelonian	23.63
White Gilkes	23.38
St. Joseph Water Hole	18.00
White Sealy	12.63
Orange Hill	12.38
Trinidadian	11.00
Bourbon	9.50
German	1.88

Statistical Note. A difference of 8.90 lb between any two variety yields has a 20:1 chance of being a significant one.

The point of great importance arising out of the above trial is the wide divergence in yield shown between the varieties when grown over a short period. It is almost certain that these yield differences would not have been so pronounced if a further growing period had been allowed. This shows the necessity of realising what a variety is able to do relative to other varieties in the growing period used. The experiment shows that Trinidadian (Black Rock), however good it may be over a longer growing season, is quite inadequate as a catch crop variety. The writer advises its discontinuation in that capacity and its substitution, for the present at any rate, with Six Weeks, or where keeping ability is required, with Red Nut.

(*d*) SEEDLING WORK.

Seeds were collected from the flowering and seeding plots mentioned above. To these were added further seeds from fields of sweet potato throughout the Island. All seeds had their coats punctured by a pin. They were soaked in water for twenty-four hours and then sown in boxes. From the latter they were pricked out into four inch pots and then put into the field under irrigation. The seedlings planted out are listed in Table II.

TABLE II.

SWEET POTATO SEEDLINGS PLANTED OUT UNDER IRRIGATION AT CODRINGTON.
APRIL 1929.

Parent Variety.	*No. Planted.*
Six Weeks	51
Trinidadian	297
Red Nut	512
St. Joseph Water Hole	7
Caroline Lea	3
White Gilkes	31
Orange Hill	36
White Nut	38
White Sealy	143
	1118

These will be experimented with during the coming rainy season.

SECTION IV. TOBACCO.

(*a*) INTRODUCTION.

The Department is testing the possibilities of the tobacco plant as a part alternative or subsidiary crop to the sugar cane. The value of the tobacco crop is determined by the yield, the quality and the cost of its production and marketing. Now, other things being equal, it is desirable to produce the best quality if there is a market for it. Here the marketing problem arises. The market may either be in Barbados or in other countries. Now, it is likely that for export, the leaf tobacco produced here would require to be of high grade quality before it would be accepted by a buyer and the cost of marketing abroad overcome by the grower. The production of high grade tobacco is costly however, and its production, together with the necessaries for its marketing would require high expenditure. On the other hand there appears to be a local market for tobacco leaf of all grades, which leaf is used either alone or for blending with better grades of imported material. The bigger the production of good leaf locally the less is required through importation. At the same time better local leaf obtains a better price in the local market. It appears, that, for the present, the better policy would be to produce, for the local market, the best possible tobacco leaf that can be grown under local conditions and cured, without the initial heavy capitalisation involved, in say, the flue curing process. It is possible that, were the production of tobacco leaf for the local market successful there would be a tendency to overstock this market by increasing the acreage of this crop. By that time, however, more will be known as to the possibilities of and best methods for growing and curing the higher grades of leaf. It may be possible that it would then pay to grow and cure the leaf for export trade, or even to produce such a grade to be manufactured locally so as to compete with the better grade of imported manufactured tobacco, either pipe or cigarette.

Tobacco has only been grown in isolated and very small areas in Barbados. The varieties used, the cultivation and especially manuring and methods of curing were not suited to the production of even a medium grade of leaf. The Department is aiming therefore at determining in how far the leaf can be influenced by these factors in order to improve the quality of the local product.

It appears, from recent tobacco statistics, that the amount of cigarette tobacco consumed during recent years is steadily rising, while the consumption of pipe and especially cigar tobacco is dropping. It appears that it is desirable to find out if cigarette tobacco leaf can be produced here, and produced at a profit.

(*b*) VARIETY YIELD TRIAL.

The type of leaf best suited for cigarette tobacco must be of a yellow colour, preferably lemon yellow. Now the colour of the cured leaf is dependent on many factors chief among which are, (1) variety (2) soil, (3) manuring (4) age of harvesting, (5) efficiency in controlling environmental factors during curing and (6) fermentation.

The first essential was, therefore, to obtain varieties suited to the production of good leaf and to test their yielding ability against the locally-grown type and to consider such yields with that obtained in other tobacco-growing countries.

The following varieties were introduced for this purpose:—Hickory Prior, Warne, Gold Leaf, White Burley, Maryland, Yellow Mammoth, and Tennessee Red and compared with the local variety, Kentucky One Sucker.

The methods adopted in the sowing and planting out were essentially those described in the departmental pamphlet recently published, except that boxes were used in place of the seed bed. The plants were put out in the fields in the furrows. The distance between the furrows was three feet and between the plants two feet. The soil prior to planting, was given farmyard manure at the rate of five tons per acre. Plants were sown on the 5th of September, 1928, and planted in the field between 26th and 30th November, 1928. Since the growing season extended into the dry season, irrigation was necessary. Three

irrigations were applied, viz 10th and 26th January and 8th February 1929. Artificial fertilizers of the following composition and amounts were intended for using per acre:—*

100.0 lb. superphosphate (16% P_2O_5)
95.0 „ nitrate of soda (18.6% N)
66.5 „ sulphate of ammonia (25 7% NH_3)
428.0 „ cotton seed meal
151.0 „ sulphate of potash (50% K_2O)
3.0 „ muriate of potash (50% K_2O)

These were applied in two lots, viz one-third of the total on 20th December, 1928, and one-third on 28th January, 1929. The remaining one-third was not considered necessary.

The plants were suckered and topped as recommended in the pamphlet previously referred to. In all varieties about fourteen leaves were allowed to develop in each plant.

The experiment was laid out in the Latin Square Form, i.e. the eight varieties each occurred eight times in the manner seen in the following plan. Letters A—H each represent one of the varieties used.

B	G	A	D	E	F	H	C
A	F	E	H	C	B	D	G
H	B	C	A	G	D	E	F
G	D	H	B	F	A	C	E
E	H	F	C	D	G	B	A
C	A	G	E	B	H	F	D
F	E	D	G	H	C	A	B
D	C	B	F	A	E	G	H

In each plot there were five rows and ten plants in each row. Each plot was 15 ft. x 20 ft. and contained fifty plants. For purposes of yield determinations the outer rows in each plot were eliminated, so that there were thirty plants in each plot from which to ascertain the plot yield. The plants in these outer rows were allowed to flower and seed, care being taken to retain purity of seed by bagging the inflorescences.

The entire plot was harvested at two distinct periods, viz., 21st February —4th March, and 21st March. The leaves were cut singly and immediately weighed for each plot, then carried to the air curing shed. At first harvesting approximately eight leaves were ready for cutting in each plant, so leaving about four or five for the second harvesting. In Table I, are summarised the weights of the green leaf for the varieties.

TABLE I.

TOBACCO VARIETY YIELD EXPERIMENT AT CODRINGTON 1928-29.

Variety	Yield of Green Leaf Per Plot of Thirty Plants, lb		Statistical Note.
Hickory Prior	32.08	(7763 lb. per acre).	An analysis of variance revealed a significant effect of variety on yield. The difference between variety mean yields per plot is 4.36 lb. for a 20.1 chance of significance.
White Burley	29.88		
Yellow Mammoth	28.18		
Kentucky One Sucker	27.31		
Maryland	27.29		
Gold Leaf	25.36		
Tennessee Red	25.13		
Warne	20.73		

Each figure is the mean of eight plot yields.

* The writer is indebted to the Agricultural Chemist for his advice in making this formula for a tobacco manure.

The field experiment shows that the varieties suited for production of yellow leaf tobacco yield very favourably under the conditions of the experiment, and, from the point of view of growth and yield, were entirely successful. The next problem is to effect a suitable curing of the leaf of such varieties in order to obtain a desirable end product.

Curing was done by the air-curing method. In this method the chief aim is to control the atmospheric humidity and this was done by the provision of adequate and controllable ventilation. It was not possible, however, in view of the many varieties and different times of harvesting, to treat each lot as it demanded. Special air-curing experiments will be carried out this year on the varieties White Burley and Hickory Prior. The colour of the cured leaf was not, as might be expected, uniform, but there was even under the enforced indifferent curing methods employed, a good proportion of light yellow leaf.

The entire crop was fermented in bulk after curing. It is hoped to send samples from the bulk to the Imperial Institute for report on their worth, etc.

The same yield trial is to be repeated this year during the rainy season.

(*c*) EXPERIMENTAL.

Two experiments were performed to test,

(i) the effect of spacing on yield, and

(ii) the effect of stopping stem elongation on the growth of the leaves remaining.

Experiment (i)—The Effect of Spacing on the Yield of Green Leaf.

The variety employed was Kentucky One Sucker and the spacings used were (1) the hole system, i.e., two plants to the same hole (5ft. x 5ft.), one in the saddle, the other on the bank, in all 3484 plants per acre and (2) the row system, i.e. rows three feet apart and plants two feet apart in the rows, thus 7260 plants per acre. The methods of cultivation, irrigation and manuring were the same for both spacings. The plots were laid out as in the following plan when H=hole system and R=row system.

H R R H H R R H H R R H H R R H H R R H

Each plot was 15ft. x 50ft. The row system plots contained each 125 plants while the hole system contained 60 plants. The plants were put out on the 3rd and 4th December, 1928, and harvested on the 26th March 1929. The weight of green leaf was determined for each plot. Students' method of statistical analysis was employed to test the significance of the difference in yield between the two spacings.

The mean difference between pairs of parallel plots in favour of the row system was found to be 16.65 lb. The standard error of this mean was—5.82, thus showing that the mean difference has a greater than 20:1 chance of being significant. The difference in favour of the row system actually amounted to 848 lb. of green leaf per acre, i.e. approximately 15% of the yield per acre, and thus shows the advantage of the spacing employed in the row system, viz. 3 ft. x 2 ft. Incidentally, it is to be remembered that this was the spacing employed in the "cigarette" plot in the previous experiment and it appeared to serve very well. The spacing employed in the hole system appears to be too wide for a maximum return of green leaf.

Experiment (ii)—To Test the effect of Stopping Stem Elongation on the Development of the Leaves.

It was desired to know if, on topping the plants, the remaining leaves were restricted in their development or if such a measure actually gave increase in leaf development over leaves of plants whose leading shoots were allowed to go on growing. In the plant at harvest, approximately fourteen leaves are desired, of as large a size as is possible with a good quality (texture). Is the size of these fourteen leaves affected by topping or no?

The variety employed was Yellow Mammoth. Twenty plants in all were selected, such that ten comparable pairs were possible. Each comparable pair of plants was selected in a plot and possessed the following relationships, (1) nearness to one another, (2) approximate similarity in size and number of leaves. It was thus possible to minimise a soil difference effect and the effect of different sized plants on the measured quantity of the experiment, i.e. leaf development. Each pair was treated in all ways alike. One member in each pair had its leading shoot and all side shoots removed, while the other, after removal of its leading shoot was allowed to develop the lateral shoot next the leading shoot. Leaf development in all plants was measured by ascertaining the length and width of two leaves in each plant over successive fortnightly period. There were two such periods during the course of the experiment. Two leaves were measured for each plant, so that, for any comparable pair of plants, there were two comparable sets of leaves. Now in each comparable set it is reasonable to think that difference in development of the leaves would be due to the difference in the treatment given the two plants. Students' method was employed here for finding the significance of the mean difference in leaf development in leaves of plants treated by the two methods described. The results are appended below in Table II.

TABLE II.

TOBACCO. EFFECT OF SUPPRESSING STEM ELONGATION ON THE DEVELOPMENT OF THE LEAVES IN YELLOW MAMMOTH TOBACCO. CODRINGTON 1929.

Period	Difference in favour of development in leaves of plants whose stem elongation has been checked over that of leaves of plants in which elongation proceeds by the growth of a lateral shoot. (Inches.)	
	Leaf Length	Leaf Width
1	0.475±0.126*	0.220 ±0.072
2	0.403±0.101	0.248 ±0.051

*All difference figures are the means of twenty comparisons.

In both periods the development in length and width of the leaves of the plants whose growth progress is checked is greater than those leaves of the plants in which a side shoot was allowed to develop. (The mean differences in all cases show greater than 100.1 chance of being significant). This shows that topping and suppression of side shoot development actually favours a slight increase in leaf development under the conditions of this experiment. Topping and suppression of shooting, moreover, appears to give a more uniform leaf which leads to easier and more efficient curing, bulking and grading. The practice of allowing plants to grow freely is to be deprecated, since it leads to an uneven size and coarse texture in the leaves and a necessity to cure this mixed product at all times during harvest. Such a state of affairs renders good curing impossible.

Growth records in each variety were made in the Latin Square Plot. Sixteen plants in each variety—two plants in each plot—were measured at weekly intervals. The increases in length of stem and the number of leaves for each period, were determined. These records will be reserved for reference and comparison in future plantings.

(*d*) CIGAR TOBACCO.

Cigar Tobacco Varieties. Seeds of the following cigar varieties were imported:—

Variety	Use.
Comstock Spanish	Filler and binder
Big Havana	,, ,,
Connecticut Havana	,, ,,
Sumatra Domestic	Wrapper

These were sown in boxes and treated in the field as in the "cigarette" tobacco experiment. They were put out on the 7th December, 1928, in a 4 x 4 Latin Square. The leaves were harvested on the 6th March, 1929, and a second picking was made on the 25th March, 1929. The weights of the green leaf were ascertained for each plot for all varieties. See Table III.

TABLE III.

TOBACCO. YIELD OF GREEN LEAF FROM CIGAR VARIETIES—CODRINGTON 1928-29.

Variety.	Mean Yield of Four Plots of 30 Plants (lb.)	Statistical Note.
Comstock Spanish	27.98	The analysis of variance shows a significant effect of variety on yield. A significant difference between varietal means (of four plots) is 3.54 lb.
Big Havana	26.86	
Connecticut Havana	22.19	
Sumatra Domestic	16.88	

Sumatra Domestic serves a distinct purpose as a wrapper in cigar manufacture. Of the three fillers and binders Comstock Spanish and Big Havana show approximately similar yields but Big Havana stood up better in the field and was not so liable to tearing in the high winds. This was a fault of Comstock Spanish. The yields of these two types approximate to the yields of the cigarette tobacco varieties. (q.v. yields of White Burley and Hickory Prior).

Cured and fermented samples of these cigar tobacco leaves will be sent to the Imperial Institute for a report on their worth.

SECTION V. COTTON.

(*a*) INTRODUCTION.

The cotton crop is at present suffering from severe pink boll worm (*Pectinophora gossypiella*, Saund) attacks. This renders its production unprofitable in pink bollworm areas. The following theoretical possibilities for escaping its depredations suggest themselves, (1) the breeding of a cotton immune to bollworm attack, (2) a direct attack on the insect through biological control or the employment of materials harmful to the bollworm, (3) avoiding its excessive harm by growing the cotton (a) at such a time as the bollworm increase is not favoured by environmental conditions or (b) for such a period as the bollworm cannot cause great harm before the complete picking of the cotton. For the present it is not likely that a variety could be obtained which would be immune to bollworm and at the same time satisfy the other economic demands made on it. This possibility may be, for practical purposes, eliminated. As to the statement under heading (2) it may be said that, for the present, at any rate, control cannot be effected by these means. The greatest hope is offered by the methods suggested under heading (3).

It appears to be established that the severity of bollworm attack is

(other things being equal) in proportion to the period of time which the cotton crop occupies the land. A crop which can produce and mature its bolls in a comparatively short time stands a better chance of escaping severe infestation, than one which bolls over an extended period. It would appear necessary therefore, that, with other desirable features, the variety should be one which bolls early and matures such bolls in a short time. Now, this raises the question as to what causes early maturity and a short bolling period. It is probable that this is inherent or varietal to a great extent but it is no doubt affected considerably by certain environmental conditions.

It has been the experience in other West Indian Islands, that cotton which bolls and matures its bolls during the dry season is not so susceptible to pink bollworm attack. It has been suggested that conditions of the environment at this time do not favour a bollworm increase. Whether this explanation be the correct one or no does not greatly concern us. Such a growing season can be actually tested for Barbados conditions and its effects on the intensity of bollworm attack noted.

Besides these suggestions for an escape from bollworm there is also before the plant breeder the continual need for improvement of the material on hand; improvement by tending towards a greater satisfaction of that demand which is going to give the greatest profit to the producer.

Summarising then, there appears to be a necessity for a variety with the following features:—

(1) high yield of seed cotton
(2) yield in a short time
(3) high lint index
(4) high quality of lint

(*b*) EXPERIMENTS ON MONOPODIAL PRODUCTION.

It was desired to know what was the effect of the growth habit of a cotton plant on the time of its production of seed cotton. Now, for any variety, the most variable feature in its habit is the extent of development of vegetative branches or monopodia. Pickings of cotton were to have been made from bolls borne on the main stem or main monopodium and from lateral vegetative branches. Unfortunately, it was impossible to do so owing to the experimental plot being infested with bollworm. Growth records however, had been made in boxes for thirty cotton plants (ten each of Barbados Sea Island, Montserrat Sea Island and American Long Staple Upland). Although, for a similar reason, it was impossible to get seed cotton weights, it was ascertained that the flowering, bolling and boll opening was prolonged for each plant by the vegetative branches (monopodia). It was also established by the statistical method of correlation that the number of sympodia or flower producing branches in each plant is directly related to the number of such vegetative branches. This was estimated in one hundred Barbados Sea Island plants in a manured plot at Codrington, September, 1928. The co-efficient of correlation was $+0.753$ ($P. > .01$). This reveals a high relationship and suggests that, for individual plants, high flowering is associated with a high number of vegetative branches, and that plants of the latter type may give higher bolling and yields of seed cotton. It must be borne in mind, however, that the bolling and time of yield of seed cotton is prolonged over a greater period in any plant by virtue of its possessing such vegetative branches. For obtaining a yield in a short time therefore, the production of vegetative shoots appears to be undesirable.

How far is it possible through control of the environmental factors to control this vegetative shoot production and, as a resultant, the time of production of bolls? Two experiments were performed, (1) to determine the effect of the condition of the soil and (2) the effect of spacing on the production of monopodia.

(1) *The Effect of Soil Condition on Production of Monopodia.*

Two areas of soil, each approximately one acre were sown with Barbados Sea Island cotton, strain S(27)6. Sowings were made practically alike as regards date and spacings (the usual spacing of five feet between rows and twenty inches between the plants was used). One area of soil, for convenience known as the "manured" area had the following treatment:—The land was forked to a depth of nine inches, the soil chipped with the hoe and a basket of manure applied to each cane hole. The other area was not forked nor manured. 100 plants

were selected in each area, by the selector making his observations on every fifteenth plant in a row. The number of monopodia was estimated for each plant. The plants at this stage were four months old. Result:—

Area.	*Mean No. of Monopodia per Plant (mean of 100 plants).*
"Manured"	5.07±0.13
"Non-manured"	3.30±0.12

The difference in favour of "manured" over "non-manured" plants for number monopodia is +1.77±0.176. This difference is highly significant.

The conclusion is that a better preparation and manuring or better treatment of the land gives, in this variety of cotton, plants with a greater number of monopodia. It had been the intention to estimate the effect of this monopodial production on the weight and time of yield of seed cotton, but boll-worm infestation prevented this.

A further argument for a soil effect on monopodial production was provided by estimating the number of monopodia produced in adjacent plants and correlating these numbers. It was thought that perhaps monopodial production might be affected by light, and that plants which "got away" early would be more likely to receive more light and as a resultant develop more monopodia. It is conceivable that if this were so, then in two adjacent plants, that one which "got away" might develop to the detriment of its neighbour's development. Thus we might expect robust plants with numerous monopodial number alongside plants with low monopodial number and as a result a negative correlation. The relationship between monopodial number in adjacent plants was determined by estimating the correlation coefficient for monopodial numbers in "central" plants with the mean number of monopodia in their two adjacent plants in the rows. This was +0.553 $P > .01$. There is actually a high positive relationship in this respect and would argue for the great influence of the soil on monopodial numbers in plants of this strain.

(2) *Effect of Spacing on Production of Monopodia.*

The same strain of cotton was employed, viz. Barbados Sea Island, S (27) 6. Two spacings were employed (1) 5′ x 20″
(2) 3′ x 20″

The experimental plot was laid out on the ABBA \etc. system (A=5′ x 20″ spacing and B=3′ x 20″). Ten replicates of each spacing were employed.

Two hundred plants were chosen in each spacing, (avoiding selection from "guard" rows) and the number of monopodia determined. The choice of plants was made by selecting every fifteenth plant in any row desired and the selections were made similar in number for the comparable plots in each spacing. Result:—

Spacing.	No. of Monopodia (mean of 200 plants).
5′ x 20″	5.45±0.115
3′ x 20″	2.96±0.080

The difference in favour of wide spaced over narrow spaced plants in number of monopodia per plant is +2.49±0.140; a highly significant difference.

Again pink bollworm infestation made it impossible to determine the effect of spacing on (1) yield of seed cotton and (2) time of such yield.

From the result it is apparent that the closer spacing between the rows gives plants with fewer monopodia. The effect of this on the yield and on the time of yield could not be determined but it is possible that the period of picking would have been shorter in the closer spaced plants. Indeed closer spacing might conceivably give as good yield per acre while giving such yield over a shorter period than the wider spaced plants. It is hoped to repeat the spacing experiment this year to test the validity of these statements since it has so important a bearing on the bollworm problem.

(*c*) VARIETY YIELD TRIAL.

The other aspect of the cotton work concerned experimenting on cotton varieties. It was thought that the Barbados strain S (27) 6 was very good in most respects but failed (in bollworm conditions) on account of its habit of producing many monopodia, thus extending the crop period and increasing the

possibilities of severe bollworm infestation. The previous experiments, recorded above, indicated methods of alleviating this by altering the environmental conditions. To these methods will be added another in due course, viz., the effect of growing the crop into the dry season. The problem of yield, quality and, above all, time of yield was studied in several imported varieties, viz. Montserrat Sea Island strain, H 23-2-13, and American Long Staple Upland strains.

The growth phenomena in all types including the Barbados strain S (27) 6 were determined for plants grown in boxes at Codrington and for plants in the field at Warrens Plantation.

Yield trials were carried out at (1) Warrens and (2) Blackmans Plantations.

The varieties used were:—

(1) Barbados Sea Island—S (27) 6.
(2) Barbados Sea Island—Taitts.
(3) Montserrat Sea Island—H. 23-2-13.
(4) American Long Staple Upland Deltatype Webber.
(5) „ „ „ „ Lightning Express.

At both places the lay out was identical, viz., 5′ x 5′ Latin Square. Following is a diagram showing this. (Letters A-E each represent one variety).

C	B	D	A	E
B	A	E	D	C
D	E	B	C	A
E	C	A	B	D
A	D	C	E	B

Each plot measured 30 feet by 25 feet. The Sea Island cotton plants were spaced twenty inches apart in rows five feet apart. There were, therefore, ninety plants per plot. The American Upland plants were planted fifteen inches apart in rows three feet apart. There were therefore one hundred and fifty plants in each plot. The Warrens experiment was ruined by severe pink bollworm attack, while the number of plots at Blackmans was reduced to four for each variety owing to taking up plants from one strip of plots to supply misses in the others.

The yield and time of yield is tabulated below in Table I.

TABLE I.

COTTON. VARIETY YIELDS AT BLACKMANS PLANTATION 1928-29. RESULTS EXPRESSED AS LB. OF SEED COTTON.

Variety	*Date Picked 1929.*															
	18:1	26:1	1:2	4:2	11:2	15:2	26:2	11:3	22:3	26:3	11:4	13:4	16:4	17:4	22:4	Total
S (27) 6 ..	...	...	0.50	3.63	2.25	6.75	6.13	9.51	4.15	...	...	6.13	3.25	1.75		44.05
"Laitts" ..	..	...	0.75	2 25	...	3.00	9.50	12.75	14.25	...	...	5.75	8 75	...	...	57.00
Montserrat 23-2-12 ...	...	...	...	..	...	0.38	8.25	11.50	21.00	...	...	14.50	2.70	...	...	58.33
Deltatype Webber ..	1.38	3.25	1.50	4.25	...	3 88	4.76	1.25	2 25	...	3.13	0 25	..	...	1 50	27.40
Lightning Express ...	2.50	3.50	3.50	4.75	4.00	2.50	1.00	1.25	1.50	...	..	1·00	...	..	..	25 25

Note.—Each figure for any variety and any date is the total picking for the four plots of the variety on that date.

VARIETIES IN ORDER OF MERIT.

Variety.	Strain.	Mean Yield Per Plot. (lb.)
Montserrat Sea Island	23-2-13 ..	14.58
Barbados Sea Island	"Taitts" ..	14.25
Barbados Sea Island	S (27) 6 ..	11.01
American Long Staple Upland ..	Deltatype Webber	6.85
American Long Staple Upland ..	Lightning Express	6.31

Statistical Note. There is a significant effect of variety on yield. A difference of more than 7.27 lb. seed cotton between varietal means of four plots may be regarded as a significant one.

Table I shows that the American Upland varieties give almost their entire yield one month earlier than the Sea Island cottons. The yield of the latter is, however, significantly heavier in the Montserrat strain and the "Taitts" strain of Sea Island. The Montserrat strain appears to be slightly later in reaching the zenith of its yield in time, but its entire yield is given over a shorter period.

The American Upland cottons used in those experiments will not be persevered with, since they do not appear to satisfy so well as the Sea Island types, the demands made at the outset. They lack the yielding ability of the Sea Island cottons, and the quality of their lint is decidedly inferior to the Sea Island types. The early maturing of the Upland types does not appear to be sufficiently great and their yield and lint qualities sufficiently good to justify their substitution for the Sea Island types.

It appears that it is desirable to hasten on maturity in the Sea Island types. This will probably be possible through methods of cultivation, manuring and by breeding and selecting in the Sea Island cottons on hand. One American upland cotton—Meade—is said to possess the desirable characteristics of Sea Island cotton together with a much quicker maturity. A sample of seed of this type has been obtained and will be tried out next year. This cotton may suit as a "catch" crop cotton.

Growing cotton at such a time that bolls are maturing in the dry season (as has been recommended by the Department) seems from the Blackmans experiment, to be quite successful so far as yield of seed cotton is concerned. The sowing of these plots was delayed until the 11th of September, 1928, and picking was carried out during the dry season (q. v. Table I for dates). The yield of seed cotton was satisfactory—for Montserrat H 23-2-13, 847 lb. per acre,—so that it would appear that so far as yield is affected there is no reason why planting should not be done then as a possible means of avoiding bollworm attack.

SECTION VI. EXPERIMENTS WITH VARIOUS ECONOMIC LEGUMES.

INTRODUCTION.

These experiments were started, with a main aim in view of finding out a plant more suitable for green manuring purposes than Woolly Pyrol (*Phaseolus mungo.*) The latter plant is well suited for growing in Barbados, but the severe insect attack to which it is in most cases subject must reduce greatly its value as a green manure. The experiments necessitated the gathering of seeds of many leguminous species, and these were sown to determine their value as green manure. At the same time, however, their ability to function for other uses was considered, e.g., for soiling (i.e., cutting while green for feeding to stock), for grazing, or for the production of peas or beans.

EXPERIMENTAL.

Seeds of various legumes were obtained. The entire experiment was divided into two sub-experiments. In one, the yield of the legumes in the green state (when they were considered to be at the best stage for cutting and turning under) was determined, while in the other they were allowed to develop to an end point, i.e. flower and seed and die down.

In the yield plots each species or strain was replicated six times and in each replication the species were randomized. In each of its plots a species was sown over a strip so wide as was considered necessary for it to vegetate over a five feet width when ready for cutting. There was a space of eight feet between adjoining species in the plots. This, therefore, allowed for a space between the vegetation of adjoining species; such space being left in order to avoid effects

on yield due to interference of the vegetation of one species with that of its neighbours. All plots were 20 ft. long. The yield plots sown on the ninth of September, and cut on the twenty-ninth of November, 1928.

The following are the species used and the nature of their sowings:—

Species.	*Method of Sowing.*
Calopogonium muconoides.	Light broadcast over a strip of 1½′ to 2′.
Crotalaria usarmoensis.	Light broadcast over a strip of 1½′ to 2′.
C. striata.	Light broadcast (in observation plots only).
Stizolobium aterrimum.	Two lines 2½′ apart, single seeds at 12″ spacing.
S. pachylobium.	Two lines 2½′ apart, single seeds at 12″ spacing.
Melilotus alba.	Light broadcast over 2′ wide strip.
M. alba var. Grundy Co.	Light broadcast over 2′ wide strip.
M. alba var. annua.	Light broadcast over 2′ wide strip.
Trifolium alexandrinum.	Light broadcast over 2′ wide strip.
Medicago sativa.	Light broadcast over 2′ wide strip.
Vigna sinensis .	Two lines 2½′ apart. Two seeds per hole. Holes 12″ apart in lines.
Vicia calcarata.	Three lines 1′ apart. Two seeds per hole and holes 12″ apart.
Glycine hispida, Strain 1.	Two lines 2′ apart; two seeds per hole .
Glycine hispida, Strain 2.	Two lines 2′ apart; two seeds per hole .
Glycine hispida, Strain 3.	Two lines 2′ apart; two seeds per hole .
Phaseolus mungo.	Very light broadcast over 2′ strip.

The produce from each plot was weighed at cutting. The following species were growth failures:—*Calopogonium muconoides, Trifolium alexandrinum. Medicago sativa, Vicia calcarata* and *Melilotas alba.* The *Glycine hispida* strains (Soya Beans) were a failure owing to persistent cutworm attacks in the cotyledonary stage. The species *Vigna sinensis* (Cowpea) gave very little foliage, although flowering and podding well. It was not considered as a green manure.

The following species were further considered for green manuring purposes:—*Crotalaria usarmoensis, Stizolobium* (both species), *Melilotus alba* var *annua,* and *Phaseolus mungo.*

The weight of the roots for any area of vegetation for any species was determined from the weight of its haulm by a multiplication factor, viz. the root/shoot ratio. The latter was obtained for any species from plants in the observation plots. Ten samples were taken, each of approximately twenty plants and weights of their haulms and roots determined. A ratio was obtained for each sample and the mean ratio of the ten samples determined to give the root/shoot ratio of the species.

The area occupied by the vegetation of any species in each yield plot was also determined to reduce the results of species to a fair comparative weight per unit area basis.

A summary of the yields of these species is given in Table I.

TABLE I.

LEGUMES FOR GREEN MANURES. YIELD OF VARIOUS LEGUME SPECIES AT CODRINGTON. SEPTEMBER TO NOVEMBER, 1928 (EACH FIGURE IS THE MEAN OF SIX PLOTS).

Species.	Area of vegetation (sq. feet).	Weight of Haulm lb.	Root/Shoot Ratio.	Weight of roots lb.	Weight of roots plus haulm lb.	Calculated weight per 200 square feet lb.
Phaseolus mungo	101.8	57.00	0.031	1.77	58.77	115.29
Stizolobium pachylobium	108.4	56 18	0.082	4.61	60.77	107.10
S. aterrimum	145.4	70.33	0.082	5.76	76.09	107.10
Crotalaria usarmoensis	53.6	23.46	0.082	1.92	25.40	88.97
Melilotus alba var annua	37.2	6.10	0.127	0.79	6.89	39.33

Nitrogen determinations* were made for each species. See Table II.

*The writer is indebted to the Agricultural Chemist for these figures.

TABLE II.

LEGUMES FOR GREEN MANURES. AMOUNT OF NITROGEN IN ONE HUNDRED POUNDS OF THE PLANT MATERIAL AT THE CUTTING STAGE.

Species	lb. Nitrogen in	
	Roots	Haulm
Crotalaria usarmoensis.	0.22	0.51
Phaseolus mungo.	0.18	0.32
Stizolobium aterrimum.	0.17	0.31
S. pachylobium.	0.13	0.28
Melilotus alba var. annua.	0.10	0.22

Hubam clover (*Melilotus alba* var *annua*) appears to be from the yield data and chemical analyses, distinctly inferior to the others and will be dropped from further trials. The *Crotalaria* species, as is common to most *Crotalarias*, is high in nitrogen, both in the haulm and roots. It, however, weighed less than the *Phaseolus* and *Stizolobium* species. From subsequent observations in the flowering plots, however, it appeared to develop considerably after the cutting of the yield plots, while the *Phaseolus* and *Stizolobium* species appeared to have reached their full development at the time the yield plots were cut. It must be borne in mind, also, that neither the Woolly Pyrol (*Phaseolus sp.*) nor the Velvet Beans (*Stizolobium spp.*) were attacked by caterpillars in the experiment, an event which generally happens to these species in the field. For these reasons it is considered that the *Crotalaria* species shows promise and further trials will justify it or no. The other *Crotalaria* species *C. striata*, had only sufficient seed to be sown in the observation plots. It showed up well and will be included in further trials.

It may be stated that all the five species which were weighed and analysed, flowered and seeded freely.

Introductions of seeds of other species have been made and these will be experimented with this year.

SECTION VII. SOYA BEANS.

Seed samples of Soya Beans were imported to inaugurate field experiments with this plant. Three varieties in all were introduced early in 1928. viz. (1) from the U.S.A., (2) from Trinidad, two strains, the latter were selections made from Venezuelan seed in 1927 and 1928.

These soya bean varieties were sown in the green manure plots, where they were, after a splendid germination, eaten down by hares or destroyed by cutworms. Another sowing was made in an area protected from hares. Germination was good and growth fairly satisfactory. The plants flowered and podded well and gave good samples of beans. The oil content of beans from samples of each variety was determined* and compared with the oil content of samples of the imported seed.

TABLE III.

SOYA BEANS. PERCENTAGE OF OIL IN IMPORTED AND LOCALLY GROWN SOYA BEANS.

Variety.	Percentage Oil.	
	Imported.	Locally Grown.
Venezuelan 1927.	17.63	21.43
„ 1928.	—	20.20
U.S.A.	—	20.27

*The oil determinations on Soya Beans and Linseed were made at the Government Laboratory.

Unfortunately, no oil determinations could be made for the imported Venezuelan 1928 and U.S.A. samples. The oil percentages of the three locally grown samples are very good.

The results are encouraging and further experiments will be made with this plant.

SECTION VIII. LINSEED.

The possibilities of the flax plant as an oil producer in Barbados were investigated.

Samples of seed of nine varieties were imported. These are listed in Table IV.

TABLE IV.

LINSEED. LIST OF IMPORTED VARIETIES.

Name.	Source.	Date of Introduction
N.D. No. 40023	North Dakota Experiment Station.	May 1928
N.D.R. No. 119	,,	,, ,,
Linota Flax	,,	,, ,,
Flor Blanca	Chacra Experimental de Pergamino.	November 1928
Mal abrigo	,,	,, ,,
Flor thahia (?)	,,	,, ,,
L 12	Pusa, India.	,, ,,
L 124	,,	,, ,,
L 121	,,	,, ,,

The Dakota collection was sown in September 1928, while all nine varieties were sown on an extensive scale near the end of February 1929. The latter sowings were irrigated. Observations were thus made for two crops. Space does not permit of detailing the methods employed in the experiments. Tentative conclusions arising from these observations are given here. The flax plant appears to have difficulty in germination and establishment under the conditions of the experiment. If this critical period is passed, growth is good. There is abundant flowering and capsule (boll) formation. The latter are, however, irregularly developed. The seed production is mediocre, while the seeds are undersized and, for the most part, shrivelled.

Oil determinations were made.

TABLE V.

LINSEED. PERCENTAGE OIL IN SEED SAMPLES OF NINE VARIETIES OF LINSEED.

Variety.	Percentage Oil.	
	Imported.	Locally Grown.
N.D.R. No. 119	36.5	34.3
N.D. No. 40023	36.8	36.5
Linota Flax	33.9	33.9
Flor Blanca	34.5	36.2
Mal Abrigo	35.4	—
Flcr thahia (?)	33.9	—
L 12	36.2	—
L 124	36.5	—
L 121	36.2	—

It would be possible to select a variety which gives a fairly good seed sample under Barbados conditions (the Indian Linseeds appear to be best for this purpose). Further field trials would also reveal which growing period was best suited to this. It appears to the writer, however, that there will always be the difficulty of obtaining good germination and establishment on account of (1) lack of a good seed bed, (2) too little surface soil moisture, or (3) excessive rainfall during the young stages.

Further field experiments with this crop will be made.

In concluding this report, the writer wishes to thank all Planters whom he has visited for their kindness shown him, their interest in this work and their helpful practical advice.

Chapter IV.

AGRICULTURAL CHEMISTRY AND GOVERNMENT LABORATORY.

REPORT OF THE AGRICULTURAL CHEMIST.

S. J. SAINT, B.Sc., A.I.C.

TABLE OF CONTENTS.

		PAGE.
SECTION I.	INTRODUCTION	60
SECTION II.	PAN BOILING AND THE ZEISS REFRACTOMETER	
	(a) The Boiling of Low Purity Molasses ..	60
	(b) The Graining of Syrups	60
	(c) Brasmoscope Control	61
SECTION III.	CRYSTALLIZATION-IN-MOTION OF LOW PURITY MASSECUITE	61
SECTION IV.	THE ANALYSIS OF THE JUICE OF DIFFERENT VARITIES OF SUGAR CANE	
	(a) The Differential Response to Similar Soil and Climatic Conditions	62
	(b) The Differential Response to Similar Soil but Different Climatic Conditions ..	65
	(c) The Phosphoric Acid in the Juice of the Cane and the Rainfall	66
	(d) The Relationship between Yield and the Ash Analysis of Sugar Cane Juice	66
SECTION V.	SOIL SURVEY WORK	
	(a) Variety Trial Plots	69
	(b) The Available Potash and Phosphoric Acid in the soil and the Yield	71
	(c) The available P_2O_5 and K_2O in the Soil and the P_2O_5 and K_2O in the Juice of the Cane	71
	(d) A Comparison of Various Methods of Determining the Availability of Phosphoric Acid and Potash in the Soil	72
	(e) Manurial Trials	74
SECTION VI.	THE FEEDING VALUE OF TYPICAL BARBADOS GREEN CROPS	75
SECTION VII.	GENERAL ANALYTICAL WORK	76
SECTION VIII.	ANALYTICAL WORK IN CONNEXION WITH VARIETY TRIALS	77
SECTION IX.	ANALYTICAL WORK IN CONNEXION WITH SUGARS AND SYRUPS	78

SECTION I. INTRODUCTION.

It is not possible in the compass of an annual report to give a detailed account of the work which has been undertaken at the Government Laboratory. For this reason an attempt has been made to eliminate all matter which is considered unnecessary as a means of showing the main results obtained. Detailed publications will be made elsewhere.

SECTION II. PAN BOILING AND THE ZEISS INDUSTRIAL REFRACTOMETER.

A detailed account of the investigation caried out at Sandy Lane Factory with the new Zeiss refractometer which was summarised in last year's report has been published (1) and reprints of this paper have been distributed.

During the past grinding season the Zeiss refractometer which had previously been installed in one of the vacuum pans was operated at Carrington Factory through the kindness of the management. Every facility was given for the carrying on of the work which was commenced last year and in consequence the work has been continued and extended.

(*a*) The Boiling of Low Purity Massecuites.

As at Sandy Lane Factory the three strike method of boiling sugar is adopted at Carrington Factory and the final low purity strike is cooled in a crystalliser before curing. With the aid of the refractometer it was found that the A and B strikes were boiled in the same manner at both factories, so that it would appear that the coefficients of supersaturation recommended for these strikes are of universal application. In the case of the C or low final purity strike the boiling was also identical up to about 60% of the striking volume. The concentration of the massecuite was then gradually raised until at a height of about 80% the supersaturation of the mother liquor had been raised to 1.35 and at a height of 100 the supersaturation reached 1.45. This supersaturation corresponded to about 96 Brix, which was the desired concentration for the massecuite. In the investigation carried out at Sandy Lane Factory it was found that the mother liquor of the final massecuite was kept at a supersaturation of 1.2 until the pan was full and, before striking, the massecuite was concentrated until the mother liquor had a supersaturation of about 1.35 which gave a Brix for the massecuite of about 93. It can be shown by calculation that the Carrington method gives a higher extraction of sucrose. It may be mentioned that the optical purity of the hot molasses is about 47° when the Brix of the final massecuite is 96 and 56° when the final massecuite is concentrated to 93 Brix. It is recommended that the final low purity massecuite should be concentrated as high as is practically possible before striking into the crystalliser. If a sufficient number of crystals be present in the massecuite there need be no fear of false grain formation.

The supersaturations given in this section have been calculated from dry matters determined with the refractometer. They are therefore higher than the true values.

(*b*) The Graining of Syrups.

It has been found possible to control the process of graining with considerable accuracy by means of the refractometer.

The method of graining which is generally adopted by pan boilers in Barbados is usually described as the "waiting" method. The syrup is concentrated until grain appears and the concentration is continued until a sufficient number of crystals is judged by eye to be present. Graining is then stopped by charging the pan with dilute syrup. The time occupied by graining varies from factory to factory but it is obvious that this method must yield grain of varying size. The longer the time taken to grain, the greater will be the difference in sizes.

It was found that, with a syrup of 85—86 optical purity graining, under practical conditions, commences when the coefficient of supersaturation of the syrup is between 1.33 and 1.35. The procedure adopted at Carrington Factory by the pan boiler to obtain sufficient grain for C strike was followed with the aid of the refractometer and will be described. At graining point the syrup occupied a volume of 40% of the striking volume of the pan. Under a vacuum of

25″ graining commenced when the refractometer indicated a concentration of about 82.2. The syrup was kept boiling with direct steam for about 9 minutes after which time the refractometer indicated a concentration of about 84.5 and the coefficient of supersaturation was about 1.6. Sufficient grain was then judged to be present and syrup was then let into the pan in three or four charges until the supersaturation of the mother liquor was reduced to about 1.15. The grain was then built up with syrup until about 66% of the striking volume of the pan was filled. Part of this grain was then cut over into two other pans until the level was reduced to about 34%. The pan was then charged with molasses.

Experiments have been carried out on graining by changing the vacuum. If, as the previous experiments show, graining does not occur until the coefficient of supersaturation reaches 1.33 and sufficient grain can be made by raising the concentration to a supersaturation of 1.6, the necessary data for graining by this method can be calculated. Graphs were drawn to give the vacuum and concentration corresponding to supersaturations of 1.3 and 1.6. By this means it was possible to boil the syrup at a high vacuum until the concentration of the syrup indicated a coefficient of supersaturation of 1.3. The vacuum was then lowered to that amount which would give a supersaturation of 1.3 when the concentration of the syrup was such as to give a supersaturation of 1.6 at the high vacuum. These data can be read off easily from the graph. The syrup was evaporated at the low vacuum until the correct concentration was reached, then the vacuum was raised and a charge of syrup was let into the pan. In this way the supersaturation of the syrup was raised suddenly from 1.3 to 1.6 and grain formed simultaneously throughout the mass. Additional grain formation was prevented by letting in syrup until the supersaturation was reduced to 1.15. Grain formed in this way was very uniform in size and the curing of low purity strikes built on the grain was found to be much more rapid. To obtain grain for an A strike it is sufficient to raise the final supersaturation to 1.5 or 1.55.

(c) Brasmoscope Control.

The method of brasmoscope control was again investigated at Carrington. This year four electrical resistance thermometers were placed vertically over one another in the pan at the levels of 25, 50, 65, and 85. With these thermometers it was possible to read the temperature accurately to 0.5° F.

When immersed in the boiling massecuite all the thermometers indicated similar temperatures irrespective of the height of the massecuite in the pan. This indicates that, even with the thick low purity massecuite, if the thermometer is covered by massecuite, the position of the thermometer in the pan has little effect on the thermometer reading. The reading of the thermometer, however, does not give a correct indication of the temperature of the boiling massecuite. With a highly concentrated low purity massecuite and with a syrup which is nearly at graining point, the temperature of the boiling material actually decreases with rise of concentration. The apparent reasons for this anomaly will be dealt with elsewhere. It follows therefore, that at those points where scientific control is most needed, viz., at the striking and at the graining point. no control can be exercised with the brasmoscope.

When the massecuite is sufficiently fluid for the temperature of the boiling material to respond to changes of concentration and vacuum, it was found that the concentrations as calculated from the brasmoscope data were too low. This verifies the results obtained last year with mercury thermometers at Sandy Lane Factory.

These investigations confirm the conclusion already reached that the brasmoscope is of little use in the cane sugar industry as a means of scientific control in pan boiling.

SECTION III. CRYSTALLISATION-IN-MOTION OF LOW PURITY MASSECUITES.

Mainly as a result of a paper by Salinas (2) who produces evidence that considerable inversion takes place in the crystalliser, an investigation has been made of the crystallisation of low purity massecuites. As was expected, the results obtained supported the results of Geerligs (3) and others that no inversion of sucrose takes place in the crystalliser. The results obtained are summarised in Table I.

TABLE I.

Time.	Brix.	Polariza-tion.	Apparent Purity.	Dry Matter.	True Sucrose.	True Purity.
At discharge	95.5	51.5	53.9	89.62	56.08	62.57
12 hrs. later	95.5	51.5	53.9	89.62	56.38	62.91
24 hrs. later	95.35	51.75	54.3	89.22	56.14	62.91
36 hrs. later	95.4	51.9	54.4	89.28	56.50	63.27
*60 hrs. later	94.9	47.25	49.8*	88.60	52.54	59.29*
84 hrs. later	..	..	..	88.79	55.89	62.95
108 hrs. later	95.4	52.0	54.5	89.54	56.21	62.77
132 hrs. later	95.1	51.25	53.9	89.40	56.04	62.68

*This sample was taken after stirring had ceased for 12 hours and the lowering of purity was due without doubt to the settling out of the heavier crystals because the purity went back as soon as the stirring recommenced.

In view of the fact that until recently (4) the saturation coefficients for sugar cane juices had not been evaluated, a study has been made of the co-efficients of supersaturation of the mother liquor in the crystalliser. It was found that the coefficient of supersaturation of the mother liquor of a final massecuite boiled to a concentration of 96 Brix was 1.25 on discharge from the pan and the temperature was 67°C. Four days later—the usual interval before curing—the temperature had dropped to 38°C. and the supersaturation of the mother liquor was 1.25. On a 20 ton massecuite it can be calculated that with this supersaturation there is about 1 ton of sucrose in supersaturated solution which would eventually crystallise out in the final molasses. This sucrose crystallising from supersaturated solution would be equivalent to about 7% of the final molasses.

The analysis of 80 final molasses in Java (5) showed that, on the average, each contained 8% of fine grain and it would appear that much if not all of this sucrose crystallises out, after curing, from the supersaturated molasses.

The theoretical aspects of crystallisation-in-motion of low purity massecuite have been studied with a view to discovering whether it would be practicable to recover part or all of this sucrose which is in supersaturated solution at the time of curing. A full account of this treatment will be published and as will be shown it would seem from the theoretical standpoint that more sucrose could be recovered from these low purity massecuites in the same time by altering the present method of cooling. It is contended that after striking from the pan, the massecuite should be kept hot until the supersaturation of the mother liquor has decreased from 1.25 to about 1.1. The massecuite can then be cooled. The object should be to maintain the viscosity of the mother liquor as low as possible although maintaining the optimum conditions for crystallisation. The principle of rapid cooling underlying the Lafeuille system of crystallisation-in-motion (6) is not regarded as theoretically sound when applied to the crystallisation of low purity massecuites.

It is hoped to continue this investigation during next crop season when the theoretical conclusions which have been deduced will be tried out in practice.

SECTION IV. THE ANALYSIS OF THE JUICE OF DIFFERENT VARIETIES OF SUGAR CANE.

(*a*) The Differential Response to Similar Soil and Climatic Conditions.

The juices expressed from the cane of the varieties Ba. 11569, B. 417, B.381, B.374 and B.H. 10(12) have been analysed in respect of Sucrose, Potash, Phosphoric Acid and Ash. Only Ba. 11569 and B. 417 were grown at all centres. It has therefore not been possible to compare all the varieties in one Table. In Tables II, III, IV, and V, the statistical examination of the figures obtained has been summarised.

TABLE II.

No. of Centres, 28.

	Ba. 11569 %	B. 417 %	Differences %	Differences ÷ Standard Deviation. t	For P=0.25 t =
K_2O/Ash ...	26.62	28.20	1.58	0.767	1.994
P_2O_5/Ash ...	13.98	11.81	2.17	2.397	1.994
K_2O/Juice ...	0.0783	0.0983	0.0200	2.062	1.994
P_2O_5 Juice ...	0.03777	0.03935	0.00158	0.704	1.994
Ash/Juice	0.2813	0.3357	0.0544	3.737	1.994
Sucrose/Juice ..	18.19	17.33	0.86	2.617	1.994

TABLE III.

No. of Centres, 13.

	Ba. 11569 %	B. 417 %	B. 374 %	Differences %	Differences ÷ Standard Deviation. t	For P=0.05 t =
	26.41	27.91		1.50	0.827	
K_2O/Ash ...	26.41		31.28	4.87	2.685	2.179
		27.91	31.28	3.37	1.858	
	12.72	11.30		1.42	2.49	
P_2O_5/Ash ...	12.72		12.88	0.16	0.281	2.179
		11.30	12.88	1.58	2.77	
	.0757	.0961		.0204	2.87	
K_2O/Juice ...	.0757		.1026	.0269	3.78	2.179
		.0961	.1026	.0065	0.91	
	.0337	.0352		.0015	0.85	
P_2O_5/Juice ...	.0337		.0399	.0062	3.52	2.179
		.0352	.0399	.0047	2.67	
	0.2765	0.3206		.0441	3.72	
Ash/Juice ..	0.2765		0.3210	.0445	3.75	2.179
		0.3206	0.3210	.0004	.034	
	18.13	17.36		0.77	2.893	
Sucrose/Juice	18.13		17.76	0.37	1.39	2.179
		17.36	17.76	0.40	1.503	

TABLE IV.

No. of Centres 20.

	Ba. 11569 %	B. 417 %	B.H.10(12) %	Differences %	Differences ÷ Standard Deviation. t	For P=0.05 t =
K_2O/Ash	25.66	27.33		1.67	1.036	2.093
	25.66		27.29	1.63	1.011	
		27.33	27.29	0.04	0.025	
P_2O_5/Ash	14.66	12.33		2.33	4.541	2.093
	14.66		13.98	0.68	1.325	
		12.33	13.98	1.65	3.216	
K_2O/Juice	0.0747	0.0923		0.0176	2.57	2.093
	0.0747		0.0771	0.0024	0.350	
		0.0923	0.0771	0.0152	2.22	
P_2O_5/Juice	0.0384	0.0402		0.0018	1.216	2.093
	0.0384		0.0380	0.0004	0.270	
		0.0402	0.0380	0.0022	1.486	
Ash/Juice ..	0.2750	0.3280		0.0530	4.715	2.093
	0.2750		0.2768	0.0018	1.601	
		0.3280	0.2768	0.0512	4.555	
Sucrose/Juice	18.45	17.60		0.85	3.485	2.093
	18.45		19.00	0.55	2.255	
		17.60	19.00	1.40	5.740	

TABLE V.

Significance of Differences between Composition of Juice of Ba. 11569, B. 417 and B.381 at 21 Centres.

	Ba. 11569 %	B. 417 %	B. 381 %	Differences %	Differences ÷ Standard Deviation. t	For P=0.05 t =
K_2O/Ash	27.11	27.76		0.65	0.456	2.086
	27.11		28.22	1.11	0.778	
		27.76	28.22	0.46	0.322	
P_2O_5/Ash	13.99	11.97		2.02	3.737	2.086
	13.99		14.68	0.69	1.276	
		11.97	14.68	2.71	5.011	
K_2OJuice	0.0807	0.0965		0.0158	2.516	2.086
	0.0807		0.0817	0.0010	0.159	
		0.0965	0.0817	0.0148	2.357	
P_2O_5/Juice	0.0382	0.0399		0.0017	1.379	2.086
	0.0382		0.0401	0.0019	1.541	
		0.0399	0.0401	0.0002	0.162	
Ash/Juice ..	0.2832	0.3345		0.0513	4.724	2.086
	0.2832		0.2795	0.0037	0.341	
		0.3345	0.2795	0.0550	5.065	
Sucrose/Juice	18.09	17.23		0.86	3.881	2.086
	18.09		17.47	0.62	2.798	
		17.23	17.47	0.24	1.083	

There are no significant differences between the ash, potash or phosphate contents of the juices of Ba. 11569, B.H. 10(12) or B. 381. The sucrose content of the juice of B.H. 10(12) is significantly higher than that of Ba. 11569 and the sucrose content of the juice of Ba. 11569 is significantly higher than that of B. 381. It follows from this that the sucrose content of the juice is a varietal characteristic and is independent of the ash content of the juice.

It will be noticed that the juice of B. 417 has a significantly higher ash content than Ba. 11569, B.H. 10(12) or B. 381. The variety B. 374 has, like B. 417, a relatively high ash content.

From the analysis it will be seen that between 30—40% of this increase in the ash content of the juice is due to potash. On the other hand there is no difference in the amount of phosphate in the juice of these varieties. This is an interesting point and would indicate if the analysis of the juice is related to the analysis of the whole plant that, under similar soil and climatic conditions, the varieties B. 417 and B. 374 absorb similar quantities of phosphate but greater quantities of potash than the varieties Ba. 11569, B.H. 10(12) and B. 381. It is evident that B. 417 and B. 374 show a different selective absorption of the available nutrients in the soil than do Ba. 11569, B.H. 10(12) and B. 381.

The data advanced under this section would lead one to suppose that varieties of sugar cane may show a differential response to manuring. For instance, in the case of the varieties under consideration it is possible that B. 417 and B. 374 would respond to larger doses of potash than Ba. 11569, B.H. 10(12) or B. 381.

These differences in the composition of the ash of varieties grown under similar conditions do not appear to have been considered by Walker (7) in his work on the relationship between the composition of the ash of the juice of the sugar cane and soil deficiencies. It is obviously necessary in judging differences due to soils to consider only one variety of cane or only those varieties which are known to respond similarly to the same soil conditions.

(*b*) The Differential Response to Similar Soil but Different Climatic Conditions.

It has not yet been possible to analyse statistically the results obtained during 1929, but in Table VI, the mean results for certain determinations in the case of the varieties Ba. 11569, B. 417 and B. 381 have been compared for the growing seasons 1927-28 and 1928-29.

TABLE VI.

	1927-28			1928-29		
	Ba. 11569	B. 417	B. 381	Ba. 11569	B. 417	B. 381
K_2O/Ash ...	27.11	27.76	28.22	29.64	30.88	27.64
P_2O_5/Ash ...	13.99	11.97	14.68	6.48	5.73	5.92
K_2O/Juice ..	0.0807	0.0965	0.0817	0.0753	0.0945	0.0704
P_2O_5/Juice ..	0.0382	0.0399	0.0401	0.0154	0.0162	0.0146
Ash/Juice	0.2832	0.3345	0.2795	0.2473	0.3003	0.2567
Sucrose/Juice	18.09	17.23	17.47	19.19	18.54	18.21

The rainfall conditions were quite different in the two years. 1927-28 can be characterised as a wet year with a mean rainfall at each centre for the sixteen months' growing season of 80.85 inches. The crop reaped at the end of this season was above the average in weight, but the juice was below the average in sucrose content. 1928-29 was a more normal year as regards rainfall. The mean rainfall at each centre for the sixteen months' growing season was 70.24 inches. The yields of cane were equal or rather less than the average in weight whilst the juice was above the average in sucrose content. This difference in the percentage of sucrose in the juice of the three varieties can be seen by reference to the mean figures given in Table VI.

The relative order in which the three varieties stand to one another in respect of the percentages of ash, potash, phosphate and sucrose in the juice does not appear to alter from season to season. As remarked upon elsewhere, the juice of B.417 has a higher ash content than the juices of either Ba.11569 or B. 381; whilst there is no difference in the amounts of phosphate in the juices. The increased ash content of the juice of B. 417 appears to be largely due to the increase in potash.

There is one outstanding difference which appears due to the climatic differences of 1927-28 and 1928-29. The amount of phosphoric acid in the juice of these varieties after the season of 1927-28 is approximately double the amount in the juice after the season 1928-29. This difference may therefore be due to the wetter soil conditions during 1927-28 with the consequent increase in the root system of the plant and in the availability of the soil phosphate.

(*c*) The Phosphoric Acid in the Juice of the Cane and the Rainfall.

The correlation between the rainfall and the amount of phosphoric acid in the juice of the cane has been calculated. In the growing season from December 1926 to March 1928 the average rainfall for the 28 variety trial centres was 80.85 inches with a minimum of 57.06 inches and a maximum of 106.70 inches.

The correlations between rainfall and the phosphoric acid in the juice of the cane for the varieties Ba. 11569 and B. 417 are given in Table VII.

TABLE VII.

	Ba. 11569	B. 417	Combined Correlation	t	For P=0.05 t=
Correlation between P_2O_5/Juice and Rainfall	+ 0.5348	+ 0.4482	+ 0.4915	3.950	2.0

There is a significant positive correlation between the phosphoric acid in the juice and the rainfall which supports the view that, on the coral limestone soil of Barbados, the rainfall influences the amount of phosphoric acid in the juice of the cane.

It may be noted that the rainfall has apparently no influence on the amount of potash in the juice of the cane.

(*d*) The Relationship Between Yield and the Ash Analyses of Sugar Cane Juice.

The ash analyses of the juices of Ba. 11569 and B. 417 for the season 1927-28, which were obtained from 28 centres, have been correlated with the yields of these varieties from those centres. The differences between the correlations for the two varieties could not be considered significant when judged by Fisher's test (8). Assuming that the values obtained for each variety belong to equally correlated populations, the value of the combined correlation has been estimated. These correlations with tests of significance are set out in Table VIII.

TABLE VIII.

Correlation Between Yield and	Correlation	t	For P = 0.05 t =
K_2O/Ash	+ 0.3550	2.658	2.0
K_2O/Juice	+ 0.3000	2.201	2.0
P_2O_5/Ash	— 0.2754	2.005	2.0
P_2O_5/Juice	— 0.1607	1.140	2.0
Ash/Juice	+ 0.1312	0.926	2.0

It will be seen that there are significant positive correlations between the percentage of potash in the ash of the juice and the yield and the percentage of potash in the juice and the yield. There is a significant negative correlation between the percentage of phosphoric acid in the ash of the juice and the yield. There is no significant correlation between the percentage of phosphoric acid in the juice and the yield or between the percentage of ash in the juice and the yield.

After the season 1927-28, 28 out of 29 centres gave cane juice which contained more than 0.02 per cent of phosphoric acid. After the season 1928-29, only 5 out of 26 centres gave cane juices which contained more than 0.02 per cent of phosphoric acid. This figure was found by Walker in Hawaii as probably the limit below which the cane would respond to phosphoric acid manuring. It is evident, however, that climatic conditions greatly affect the amount of phosphoric acid in the juice and from the results so far obtained it appears that, under Barbados conditions, little can be foretold of the phosphate status of the soil from determination of phosphoric acid in the juice.

Climatic conditions do not appear to affect greatly the percentage of potash in the juice but, as already shown, the variety does have some effect under similar soil conditions. With Ba. 11569, in the season 1927-28, the juice fom 7 out of 29 centres had less than 0.05 per cent of potash. With the same variety in 1928-29 the juice from 5 out of 26 centres had less than 0.05 per cent. of potash. The figure of 0.05 per cent. potash in the juice is the figure suggested by Walker as the minimum for Hawaiian conditions.

It has been shown that there is a significant positive correlation between the percentage of potash in the juice and the yield, and it would therefore appear that the analyses of the juice will give indications of the need of the soil for potash.

The mean values for the composition of the juices of Ba. 11569 and B. 417 for each of 29 centres are given in Table IX A. for the season 1927-28 . In Table IX B. are given the mean values of the same two varieties for the season 1928-29 and similar stations have been given the numbers adopted for 1927-28.

TABLE IX A.

Mean Values For Ba. 11569 and B. 417. (*Season* 1927–28).

Station.	Yield Tons Per Acre.	Sucrose Juice %	Juice Ash %	P_2O_5 Juice %	P_2O_5 Ash of Juice %	K_2O Juice %	K_2O Ash of Juice %
1	33.55	17.93	0.2917	0.0435	15.1	0.0704	23.6
2	33.68	18.15	0.3540	0.0427	12.1	0.1198	33.6
3	38 31	17.66	0.2999	0.0290	9.7	0.0888	26.3
4	39.53	16.85	0.3987	0.0388	9.8	0.1572	39.4
5	34.83	16.93	0.2503	0.0285	11.4	0.0501	19.3
6	27.59	16.27	0.3450	0.0460	13.5	0.0904	26.1
7	36.50	17.27	0.3357	0.0376	11.3	0.1008	29.8
8	26.79	17.90	0.2828	0.0333	11.8	0.0589	20.4
9	32.45	16.86	0.2945	0.0378	13.4	0.0881	29.2
10	45.02	16.06	0.2959	0.0276	9.4	0.0967	32.7
11	37.50	16.95	0.2514	0.0401	16.3	0.0557	21.3
12	33.80	17.70	0.3389	0.0162	4.8	0.1152	33.8
13	29.11	19.11	0.4167	0.0263	7.5	0.1542	32.1
14	38.59	19.50	0.2888	0.0437	15.4	0.0731	25.0
15	27.60	17.95	0.2638	0.0381	14.5	0.0406	15.4
16	36.06	18.23	0.2760	0.0458	17.0	0.0818	29.3
17	..	17.45	0.2393	0.0519	22.3	0.0597	24.4
18	39.53	15.64	0.3070	0.0380	12.4	0.0929	30.3
19	30.64	18.65	0.2511	0.0369	14.9	0.0453	18.0
20	25.33	17.49	0.3383	0.0399	12.0	0.0574	17.5
21	34.80	18.08	0.3782	0.0251	10.7	0.1314	34.6
22	30.50	19.44	0.2951	0.0508	18.0	0.0899	29.3
23	26.97	15.86	0.3250	0.0541	16.5	0.0570	18.1
24	25.15	17.67	0.2735	0.0478	17.9	0.0712	24.7
25	29.09	17.33	0.2616	0.0381	14.6	0.0833	28.5
26	19.07	18.60	0.2479	0.0319	12.9	0.0480	19.6
27	40.42	18.41	0.3771	0.0426	11.0	0.1348	35.2
28	32.08	19.09	0.3032	0.0343	11.4	0.1076	35.3
29	31.75	19.45	0.2958	0.0450	15.5	0.1037	34.2

TABLE IX B.

Mean Values For Ba. 11569 and B. 417. (Season 1928–29)

Station	Yield Tons per Acre.	Sucrose Juice %	Ash Juice %	P_2O_5 Juice %	P_2O_5 Ash of Juice %	K_2O Juice %	K_2O Ash of Juice. %
2	33.28	18.76	0.2806	0.0222	8.14	0.0780	27.28
3	26 19	18.30	0.3114	0.0158	5.09	0.1059	33.63
4	34.14	18.34	0.4290	0.0200	4.67	0.1892	44.11
5	30.21	16.84	0.2206	0.0171	7.79	0.0327	14.93
6	27.50	17.79	0.2725	0.0198	7.26	0.0402	28.72
7	32.47	16.54	0.3530	0.0140	4.01	0.1512	41.71
8	33.29	19.05	0.2359	0.0151	6.52	0.0710	30.07
9	29.11	17.93	0.2779	0.0156	5.72	0.1133	39.85
10	27.52	17.49	0.2882	0.0193	6.71	0.1003	34.78
11	26.52	16.01	0.3433	0.0199	5.80	0.1558	45.40
14	31.58	17.90	0.2188	0.0196	8.96	0.0551	25.22
15	28.10	18.26	0.2136	0.0100	5.01	0.0404	18.51
18	36.17	20.05	0.3104	0.0008	0.27	0.0925	29.57
19	34.69	19.26	0.1961	0.0265	13.50	0.0516	26.42
20	20.97	19.98	0.2597	0.0190	7.36	0.0608	23.23
20 R	21.77	19.36	0.2483	0.0097	3.88	0.0649	26.32
21	31.87	20.08	0.2324	0.0158	6.77	0.0436	18.20
22	23.94	20.32	0.2778	0.0161	5.77	0.0859	31.08
23	32.94	20.72	0.3001	0.0196	6.74	0.1011	33.51
24	25.90	20.66	0.2054	0.0240	11.78	0.0460	22 67
25	21.66	20.57	0.3157	0.0008	0.24	0.1027	32.52
26	22.25	20.08	0.2451	0.0129	5.25	0.0571	23.30
27	32.86	16.95	0.2815	0.0191	6.79	0.1041	36.86
27 R	32.40	17.86	0.2577	0.0203	7.88	0.0975	37.76
28	27.75	20.74	0.2613	0.0063	2.44	0.0700	26.66
29	29.59	20.65	0.2828	0.0128	4.50	0.0979	34.48

SECTION V. SOIL SURVEY WORK.

(*a*) Variety Trial Plots.

Samples of soil have been taken at the time of reaping from all of the variety trial plots and analyses carried out on the samples taken in 1928 are given in Table X.

TABLE X.

Soil Number.	Parish.	Index of Texture	% Sand.	% Calcium Carbonate	pH.	% Loss on Ignition (Less CO_2)	% Humus	% Nitrogen	% Citric Soluble P_2O_5	% Total P_2O_5	% Relative Solubility of P_2O_5	% Citric Soluble K_2O	% Total K_2O	% Exchangeable K_2O
1	St. George	28	7.5	12.0	8.7	11.9	0.41	0.153	0.0691	0 3008	23.0	.00454	.1003	.00817
2	St. Philip	28	6.2	3.9	8.5	12.1	0.38	0.137	0 0577	0.3060	18.9	.00633	.1071	.01140
3	Ch. Ch.	31	3.9	4.4	8.6	15.5	1.39	0.141	0.0259	0.1090	23.8	.00468	.1703	.01583
4	Ch. Ch.	33	4.6	9.8	8.45	13.8	0.30	0.131	0.2467	0.5064	48.7	.02059	.1951	.03749
5	Ch. Ch.	28	7.6	0.7	8.3	11.9	0.75	0.115	0.0197	0.1470	13.4	.00609	.1297	.00701
6	St. Lucy	29	10.3	0.4	8.1	13.0	1.00	0.107	0.0855	0.2419	35.4	.00348	.1252	.00899
7	St. James	21	27.4	5.4	8.5	9.3	0.37	0.100	0.0365	0.1324	27.6	.00829	.1263	.00983
8	St. Philip	26	13.8	2.6	8.3	10.9	0.84	0.121	0.0157	0.0966	16.3	.00706	.1274	.01367
9	St. Peter	23	16.7	1.9	8.3	12.0	0.52	0.139	0.0092	0.1110	8.3	.00792	.1094	.01088
10	St. Michael	28	14.8	11.5	8.2	11.8	0.83	0.138	0.0498	0.1463	34.0	.01098	.1500	.01957
11	St. Michael	26	7.1	1.5	8.4	12.1	0.79	0.153	0.0298	0.2324	12.8	.00783	.0947	.01112
12	St. John	32	5.4	15.5	8.7	13.0	0.30	0.134	0.0307	0.0975	29.9	.01061	.2199	.01802
13	St. John	32	5.5	25.7	8.5	12.5	0.48	0.122	0.0700	0.1908	36.7	.01109	.4611	.03785
14	St. Thomas	25	7.8	2.7	8.5	14.6	0.55	0.164	0.0208	0.2085	10.0	.01017	.1432	.01501
15	St. Thomas	22	5.1	7.8	8.5	14.6	0.60	0.173	0.0214	0.2458	8.7	00476	.1522	.01379
16	St. John	21	10.0	0.9	8.3	17.2	0.61	0.174	0.0554	0.4112	13.5	01113	.1849	.02203
17	St. John	22	8.8	0.6	8.0	14.6	0.59	0.149	0.0502	0 5832	8.6	.00487	.3596	..
18	St. John	27	6.5	1.6	8.3	15.7	0.38	0.148	0.0186	0.1745	10.7	.00827	.0688	.01549
19	St. John	25	6.9	3.0	8.3	15.1	0.33	0.161	0 0163	0.1817	9.0	.00615	.0631	.01869
21	St. Thomas	27	6.8	2.2	8.3	16.2	0.69	0.150	0.0151	0.1932	7.8	.00575	.1026	.01968
22	St. Thomas	27	10.1	2.2	8.3	17.3	0.68	0.175	0.0370	0.2869	12.9	.00955	.1410	.01878
23	St. Joseph	23	6.5	0.9	8.3	15.2	0.39	0.161	0.0106	0.2032	5.2	.00454	.1556	.01242
24	St. Joseph	15	7.1	4.0	8.3	14.4	0.38	0.177	0.0106	0.1817	5.8	.00640	.1184	.01088
25	St. Joseph	26	5.6	0.5	8.0	14.1	0.35	0.179	0.0025	0.1377	1.8	.00944	.1229	.01729
26	St. Joseph	26	5.0	0.3	8.4	14.3	0.40	0.186	0.0050	0.1635	3.1	.00941	.1206	.01483
27	St. Thomas	24	5.3	1.4	8.1	14.3	0.41	0.182	0.0123	0.1865	6.6	.00904	.1297	.03184
28	St. Thomas	24	5.5	1.1	8.1	12.8	0.47	0.174	0.0087	0.1578	5.5	.01182	.1297	.02422
29	St. Thomas	29	7.7	1.7	8.3	15.0	0.55	0.207	0.0195	0.2013	9.7	.00937	.1432	.01607

The variety trial plots are scattered all over the Island and the soils are representative of the types derived from the coral limestone area which covers the major portion of Barbados. These coral limestone soils have, in the past, been divided into Red, Intermediate Red, Intermediate Black and Black soils according to the colour which they show in the field. According to Harrison (9) there is no difference in the genesis of the red and black soils. The red soils merge into the black without the sharp distinctions implied in this colour classification. The colour difference is without doubt due to the difference in age of the two types of soil. The red soils are older than the black soils and have been subject to a greater degree of weathering. The red soils occur usually only at levels above 500 ft. and are situated in the districts of greatest rainfall. As would be expected from their history and altitude, the red soils are somewhat lighter in texture than the black and are less able to withstand dry conditions. The index of texture figure varies between 21—33 over the red and black soils and shows that texture differences are not considerable.

All the soils on the coral limestone formation contain free calcium carbonate and the pH of these soils varies between 8.0 and 8.5. It can be confidently predicted that the sugar cane will not respond to additions of lime on any of these soils.

(*b*) The Available Potash and Phosphoric Acid in the Soil And the Yield.

As the yield of cane was known for the variety trial plots, the correlations existing between the available potash and phosphoric acid and the yields have been calculated for the varieties Ba.11569 and B.417. The results are summarised in Table XI.

TABLE XI.

Correlation Between Yield and	Ba. 11569	B. 417	Combined Correlation.	t	For P = 0.05 t =
Citrus P_2O_5	+0.2167	+0.3254	+0.2711	1.972	2.0
Relative Solubility P_2O_5	+0.4261	+0.3565	+0.3913	2.977	2.0
Citrus K_2O	+0.1920	+0.3826	+0.2873	2.100	2.0

Large correlations are not to be expected in view of the fact that so many factors influence yield; but the significant positive correlations obtained indicate that additions of potash or phosphoric acid to those soils containing the smaller amounts of these constituents are likely to be beneficial.

The red soils are most deficient in available phosphoric acid and an experiment has been put down on a typical red soil to test the effect of varying additions of phosphoric acid on the yield. The manurial trials carried out at Dodds from 1894 onwards resulted in Mr. J. R. Bovell (10) recommending that phosphate manuring could be profitably omitted. It is possible that phosphate reserves are becoming deficient on the red soils and that phosphate manuring could now be recommended with advantage. It is hoped that by next year it will be possible to make definite recommendations on the point.

(*c*) The Available P_2O_5 and K_2O in the Soil and the P_2O_5 and K_2O In the Juice of the Cane.

The correlations existing between the available phosphoric acid and potash in the soil and the phosphoric acid and potash in the juice of the cane grown on these soils have been worked out for the varieties Ba.11569 and B.417. The results are given in Table XII.

TABLE XII.

Correlation between	Ba. 11569	B. 417	Combined Correlations.	t	For P = 0.05 t =
K_2O/Juice and Citric Soluble K_2O	+0.4047	+0.5917	+0.4982	4.022	2.0
P_2O_5/Juice and Relative Solubility of P_2O_5	—0.3200	—0.3110	—0.3155	2.327	2.0

It will be seen that there is a significant positive correlation between the available potash in the soil and the potash in the juice of the cane grown on that soil. On the other hand there is a significant negative correlation between the available phosphoric acid in the soil and the phosphoric acid in the juice of the cane. It would appear from these figures that the amount of phosphoric acid in the juice is affected by other factors than the availability of the phosphoric acid in the soil as measured by its solubility in citric acid. It has been shown that there is a significant positive correlation between the available phosphoric acid in the soil and the yield. It therefore follows that in judging the phosphoric acid status of the coral limestone soils in Barbados, it is better to rely on the analyses of the soil than on the analysis of the juice of cane grown on that soil.

The amount of potash in the juice of the cane is related both to the available potash in the soil and to the yield.

(*d*) A Comparison of Various Methods of Determining the Availability of Phosphoric Acid and Potash in the Soil.

The following methods of determining the phosphoric acid and potash in the soil have been carried out on the 28 samples taken from the variety trial plots, which samples can be regarded as representative of the red and black soils of the coral limestone formation. The analytical results are given in Table XIII.

1. *Citric Solubility Method.* This is the old method of Dyer (11) in which the soil is shaken up with a 1% soultion of citric acid. In these determinations sufficient citric acid was added to give a 1% solution of citric acid after the calcium carbonate had been neutralised. The soil was thus shaken up with citric acid and a solution of calcium citrate. Both phosphoric acid and potash were determined in the filtrates.

2. *Oxalic Solubility Method.* It was thought that oxalic acid might give a better estimate of the availability on these calcareous soils. Owing to the insolubility of calcium oxalate it is possible to treat all soils irrespective of their content of calcium carbonate with a 1% solution of oxalic acid without secondary effects due to the reaction of the acid and free carbonate. The method which has been previously suggested by Vanstone (12) was carried out in precisely the same way as the citric method except that oxalic acid was substituted for citric acid.

3. *Relative Solubility of* P_2O_5. This is Lemmermann's method in which the percentage of the total phosphoric acid which is soluble in 1% citric acid is determined. According to Lemmermann (13) soils containing over 25 mgm. of citric soluble phosphoric acid per 100 grm. soil do not require phosphatic fertilizers if the relative solubility is greater than 25%. Only six out of the 26 soils can, on this basis, be said not to require phosphates. This supports evidence already put forward that many Barbados soils would very probably respond to phosphate manuring. This especially applies to the red soils. In the Table the soils numbered from 1—13 would be classified as black, whilst those numbered from 14—29 would be classified as red.

4. *Water Soluble* P_2O_5. The colorimetric method of Atkins (14) has been modified and used for determining the phosphoric acid soluble in water. This method has the great advantage of rapidity and if the results are comparable to

those obtained by other methods, is worthy of adoption. In the method developed at the Laboratory the colour obtained is estimated in a Lovibond's Tintometer, so that the continual making up of standards is eliminated. Standard colours developed from solutions containing known amounts of phosphate had previously been matched against the colour units of the Lovibond tintometer. The results have been expressed as a graph so that the colour units can be readily changed into the equivalent amounts of phosphoric acid.

5. *Exchangeable* K_2O. The exchangeable potash replaced from the soil by leaching with normal ammonium chloride solution has been estimated. It might be mentioned that subsequent to the potash estimation, the ammonia retained by the soil after washing the soil free of chlorine with water and alcohol, has also been determined by Kelly's (15) method as a measure of the total replaceable bases.

With the exception of the colorimetric method used for estimating the water soluble phosphates phosphoric acid has, in all cases, been estimated by the volumetric molybdate method and the potash has been estimated by the volumetric cobalt chloride method.

TABLE XIII.

Availability of Phosphoric Acid and Potash in the Soil.

	Oxalic Soluble P_2O_5%	Citric Soluble P_2O_5%	Total P_2O_5%	Relative Solubility P_2O_5%	Water Soluble P_2O_5 p.p.m	Oxalic Soluble K_2O%	Citric Soluble K_2O%	Exchangeable K_2O %
1	0.1213	0.0691	0.3008	22.97	1.35	.00341	.00454	.00817
2	0.0812	0.0577	0.3060	18.86	2.33	.00269	.00633	.01140
3	0.0370	0.0259	0.1090	23.76	0.35	.00189	.00468	.01583
4	0.3562	0.2467	0.5064	48.71	33.00	.00494	.02050	.03749
5	0.0240	0 0197	0.1470	13.40	0.58	.00291	.00609	.00701
6	0.1281	0.0855	0.2419	35.35	3.20	.00163	.00348	.00899
7	0.0603	0.0365	0.1324	27.57	0.90	.00283	.00829	.00983
8	0 0246	0.0157	0.0966	16.25	0.13	.00254	.00706	.01367
9	0.0152	0.0092	0.1110	8.29	0.05	.00180	.00792	.01088
10	0.0656	0.0498	0.1463	34.04	1.31	.00418	.01098	.01957
11	0.0422	0.0298	0.2324	12.82	0.51	.00163	.00783	.01112
12	0.0364	0.0307	0.0975	29.94	0.75	.00617	.01061	.01802
13	0.0866	0.0700	0.1908	36.69	1.14	.00625	.01109	.03785
14	0.0300	0.0208	0.2084	10.00	0.13	.00334	.01017	.01501
15	0.0434	0.0214	0.2458	8.71	0.43	.00142	.00476	.01370
16	0.0986	0 0554	0.4112	13.47	2.15	.00541	.01113	.02203
17	0.0725	0.0502	0.5832	8.61	..	.00294	.00487	..
18	0.0234	0.0186	0.1745	10.67	0.04	.00189	.00827	.01549
19	0.0226	0.0163	0.1817	8.97	0.00	.00174	.00615	.01869
21	0.0323	0.0151	0.1932	7.79	0.00	.00345	.00575	.01968
22	0.0611	0.0370	0.2869	12.90	0.76	.00527	.00955	.01878
23	0.0146	0.0106	0.2032	5.22	0.01	.00142	.00454	.01242
24	0.0130	0.0106	0.1817	5.83	0.00	.00265	.00640	.01088
25	0.0030	0.0025	0.1377	1.81	0.01	.00725	.00944	.01729
26	0.0075	0.0050	0.1635	3.06	0.00	.00294	.00941	.01483
27	0.0230	0.0123	0.1865	6.59	0.00	.00770	.00904	.03184
28	0.0139	0.0087	0.1578	5.51	0.01	.00472	.01182	.02422
29	0.0315	0.0195	0.2013	9.69	0.17	.00291	.00937	.01607

The correlations between the various methods of determining availability have been worked out and are given in Table XIV.

TABLE XIV.

	Correlation	t	For P = 0.05 t =
Citric P_2O_5 and Oxalic P_2O_5 ...	0.9923	40.851	2.056
Citric P_2O_5 and Relative Soluble P_2O_5	0.9146	11.538	2.056
Citric P_2O_5 and Water Soluble P_2O_5	0.9356	13.512	2.056
Citric K_2O and Oxalic K_2O ...	0.5694	3.532	2.056
Citric K_2O and Exchangeable K_2O ...	0.7223	5.326	2.056
Oxalic K_2O and Exchangeable K_2O ...	0.8456	8.077	2.056
Citric K_2O and Relative Soluble P_2O_5	0.4444	2.526	2.056

The correlations between the various methods of determining the availability of phosphoric acid are very high and, for Barbados conditions, it is evidently of no advantage to use the more laborious and elaborate methods. It has been decided therefore to adopt the water soluble colorimetric method for routine determinations.

The agreement between the oxalic and the citric soluble methods of determining potash is not so good, but this, without doubt, is due to the fact that in the citric soluble method there is in addition to the 1% solution of acid, calcium citrate of varying concentration in solution to react with the replaceable potassium in the soil; while in the oxalic soluble method only the hydrogen ionised from the oxalic acid reacts with the absorbed potassium. This assumption is also supported by the fact that, although oxalic acid is a stronger acid than citric, the oxalic method has yielded less potash than the citric method. As would be expected, however, the oxalic method brings more phosphoric acid into solution than the citric method. In this case there are no exchangeable reactions involved.

The exchangeable potash is well correlated with both the citric soluble and oxalic soluble potash. As the exchangeable potash represents a more definite figure than either of the others, it has been decided to determine potash by the replacement method.

It is interesting to note that the available potash shows a significant positive correlation with the available phosphoric acid in these soils.

(*e*) Manurial Trials.

In connexion with the soil survey work it has been thought advisable to put down manurial trials.

Two types of trial have been planned and each type has been laid out in the form of randomised blocks with six replicates. Each type is put down at two centres; one centre is representative of the black soil area and the other of the red soil area.

In one type of trial the soil has been given a uniform dressing of trash and the individual plots have been manured differently with nitrogen, phosphoric acid and potash.

In the second type of trial, various kinds of organic manures have been applied such as pen manure, trash, sheep manure, cotton seed meal and other manures with local reputations.

These trials will be described in next year's report in greater detail when the yield results have been obtained.

SECTION VI. THE FEEDING VALUE OF TYPICAL BARBADOS GREEN CROPS.

As the result of a lecture given to the Agricultural Society on the feeding of dairy cows, an investigation has been made of the composition and feeding value of some of the green forage crops used on the plantations. Unfortunately, only a limited number of samples were received at the Laboratory so that the figures cannot be taken as truly representative of average samples. The analytical figures obtained are set out in Table XV.

TABLE XV.

	Moisture	Protein	Fat	Carbohydrates		Ash
				Soluble	Fibre	
	%	%	%	%	%	%
Sour Grass (mean of 4)	24.30	3.27	1.82	36.80	27.54	6.27
Sour Grass (Lunatic Asylum Farm)	52.15	1.18	1.08	24.20	17.23	4.16
Elephant Grass	90.26	1.37	0.19	3.85	2.76	1.57
Guinea Corn	77.64	1.76	0.46	10.05	8.03	2.06
Sugar Cane Tops	77.10	1.10	0.35	13.84	6.66	0.95

The Starch Equivalent and Protein Equivalent of these foods have been calculated from their analyses and these figures together with the percentage of dry matter are given in Table XVI.

TABLE XVI.

	Sour Grass.	Elephant Grass.	Guinea Corn.	Sugar Cane Tops.
Starch Equivalent per 100 lb.	18.0	4.4	10.7	11.2
Protein Equivalent per 100 lb.	1.35	0.45	0.6	0.4
Dry Matter	75.70	9.7	22.3	22.9

Sour Grass. Four of the five samples of Sour Grass received at the Laboratory contained 75% of dry matter; the fifth sample contained 50% of dry matter. The samples were therefore in a very dried condition but this is the usual condition of sour grass when fed.

The analyses show that the feeding value of sour grass is very poor. 40 lb. of sour grass of the quality received would contain 0.54 lb. of protein equivalent, 7.20 lb. of starch equivalent and 30 lb. of dry matter. A cow would be able to eat little, if any, more dry matter than this and yet she would not be receiving sufficient protein for maintenance purposes.

Speaking generally, it can be said that the sour grass pastures of Barbados have been cut annually for fifty or more years without any return in the form of manure. In my opinion, the importance of manuring cannot be overestimated. Judicious manuring would not only improve the quantity of the grass but would also improve the quality. If 30 lb. of sour grass of the present composition is allowed per head per day, then it is necessary to feed in addition 1½ lb. of concentrated foods in order to supply the purely maintenance needs of the animal. Correct manuring would so improve the feeding value of the pasture that cake additions would be unnecessary. The cost of manuring would be more than counterbalanced by the diminished cake bill.

Recent research work in England has shown that the dry matter of young grass from properly manured pastures has the feeding value of linseed meal.

Elephant Grass. Only one sample of this grass was received. This sample contained a little over 90% of water, so that there was only 10 lb. of dry matter per 100lb of food. The nutrients in the dry matter however, are well balanced and if this was a representative sample, 150 lb. of Elephant grass would supply 0.68 lb. of protein equivalent, 6.60 lb. starch equivalent and 15 lb. of dry matter which can be regarded as a balanced maintenance ration.

Guinea Corn. Only one sample of Guinea corn was recieved and this contained a little over 22% of dry matter. 75 lb. of Guinea corn—which is the amount usually fed per head per day—would provide 0.45lb protein equivalent, 8.02lb of starch equivalent and 16½lb dry matter. It will be seen that Guinea corn is deficient in protein and although 75½ provides more than sufficient starch equivalent for maintenance, 50% more protein is needed. This deficiency must be made up in the production ration of concentrated foods.

Sugar Cane Tops. This green food contains about 23% of dry matter. 75 lb. of sugar cane tops would supply 0.30 lb. protein equivalent, 8.40 lb. starch equivalent and 17 lb. dry matter. These figures show that sugar cane tops are even more deficient in protein than Guinea corn. The deficiency must be made up by incorporating protein rich foods in the production ration.

The staple green crops used for feeding purposes in Barbados are, on the whole, deficient in protein and an effort should be made to grow green leguminous crops such as soya beans which are rich in protein in order to overcome this deficiency without having to resort to expensive protein rich concentrated foods.

SECTION VII. GENERAL ANALYTICAL WORK. (C.A.C.)

Under this head 723 samples of various kinds have been dealt with. These samples are made up as follows:—

(*a*) *Police Department.*

Viscera and Examination for suspected poisons	5
Counterfeit Coins	12
Milks	240

Samples of dumplings suspected of containing poison were found to be free from injurious substances.

The stomach contents of a man were examined and found free from mineral and vegetable poisons.

5¼ grains of powdered glass were separated from about 5 fluid ounces of cocoa intended for drinking.

A sample of rum suspected of containing poison was found to contain 1¼ grains of quinine hydrochloride.

A liquid submitted was found to be commercial sulphuric acid (Oil of Vitriol).

The coins submitted were counterfeit; these coins purporting to be sovereigns were of base material, lightly gilded. The coin was struck and not moulded as is the usual case. Their manufacture appeared to be undoubtedly foreign.

The samples of local milk submitted represent a decrease of 91 on the number of 1927 samples. The percentage of adulterated samples was 17.1 as against 19.0 for 1927.

(*b*) *Customs Department*

Condensed Milks	11
Spirituous Liquors	1
Petroleum	138

Five samples of condensed milks failed to reach the standard of English regulations, whilst three other samples were found unfit for human consumption.

All samples of petroleum examined for flash point were well within the limits prescribed by the Petroleum Act.

(c) *Department of Science and Agriculture.*

Fertilizers	3
Waters	12

The fertilizers used at Codrington Experimental Station were analysed as were the samples of monthly rain water collected at the meteorological station.

(d) *Waterworks Department.*

Waters	10
Fuel Oil	4

Quarterly analyses of the water supplied by the Department through its mains were made. The usual high quality was maintained.

Analyses were carried out on the fuel oils used at the pumping stations.

(e) *Analytical Committee.*

Fertilizers	39
Feeding Stuffs	37
Sugars and Molasses	15

76 samples of various fertilizers and feeding stuffs taken on surprise visits by members of the Analytical Committee of the Agricultural Society were analysed. A good quality of both products was maintained.

15 samples of sugar and molasses were submitted for analysis in connexion with the Annual Industrial Exhibition.

(f) *Mental Hospital.*

Water	10

The samples of water obtained from the well on the premises were submitted monthly. A high degree of purity was maintained throughout the year.

(*g*) *Miscellaneous.*

Number	50

The miscellaneous analyses and investigations carried out included:—

(1) Examining and ascertaining the constants for the various coins of the new design as supplied from the British Mint.

(2) Calibration of new set of alcoholometers.

(3) Fixing water equivalent value of new stainless steel bomb for Berthelot-Mahler calorimeter.

(4) Constants and corrections for saccharometers, calcimeters, etc.

(5) Investigations of high temperature ignitions with aid of new electric furnace equipped with rheostat and pyrometer control.

(6) Determinations of calorific value, pressure, etc. of local coal gas. Results indicate the maintenance of a uniform quality which is slightly higher in calorific value than in 1927.

(7) Preparation of sterile quinine hydrochloride and chloretone solutions for injections in containers of permanent sterility. Carried out in connexion with malarial epidemic. About 2,000 injections were prepared.

Unofficial Samples.

Fertilizers	18
Feeding stuffs	15
Cane Juices	59
Spirituous Liquors	14
Miscellaneous	40

Under this head are included samples submitted by local trading firms and plantations.

The miscellaneous items include condensed milks, molasses, hydrometers for calibration, waters for domestic uses, fuel and petroleum oils, etc.

SECTION VIII. ANALYTICAL WORK IN CONNECTION WITH VARIETY TRIALS.

The milling and analytical operations in connexion with the seedling cane experiments were conducted as in 1927—28.

The electric cane mill was used throughout the crop and functioned without a single failure.

A small hand operated 2 roll laboratory cane mill was belt driven and used for crushing single canes in the maturity trials, and in some other experiments. It proved a very successful adjunct where the 3 roll equipment was excessively large for the purpose.

Milling operations started on January 9th and ended on May 30th.

3,932 samples of cane juice and 388 samples of megass were analysed. This represents a very large increase over the 1927—28 crop when 1190 samples of juice and 358 samples of megass were analysed.

SECTION IX. ANALYTICAL WORK IN CONNECTION WITH SUGARS AND SYRUPS.

The analyses of samples of sugars and syrups sent in to Bridgetown from the factories, which were formerly carried out in a private capacity, have this year been undertaken by the Government. Up to date (15th of June) 30,259 samples of sugar and 5,667 samples of syrup have been analysed and reported on.

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Chapter V.

ENTOMOLOGY.

REPORT OF THE ENTOMOLOGIST.

TABLE OF CONTENTS.

			PAGE.
SECTION	I.	INTRODUCTION	80
„	II.	CANE MOTH BORER	80
„	III.	CANE ROOT BORER	82
„	IV.	FOOD HABITS OF DR. MORRIS BIRD ..	83
„	V.	DESTRUCTION OF MONGOOSE	83
„	VI.	PINK BOLLWORM	83
„	VII.	SUBSIDIARY INSECT PESTS	84
„	VIII.	INSECT COLLECTION	84

Chapter V.

ENTOMOLOGY.

REPORT OF THE ENTOMOLOGIST.

(R. W. E. TUCKER, M.A., B.Ed.).

SECTION I. INTRODUCTION.

The duty of Entomologist to the Department of Science and Agriculture was assumed on my arrival in Barbados towards the end of July, 1928.

A survey of the principal cane pests was first made and past records and literature relating to them worked over. A plan of campaign was then formulated and the necessary equipment, etc., arranged for.

It was decided to tackle primarily the cane moth borer *Diatraea saccharalis,* Fabr. and concurrently with this, the root borer *Diaprepes abbreviatus,* Linn. and to assist in the control of the pink bollworm *Pectinophora gossypiella,* Saund. Other minor pests were dealt with as occasion permitted, and as detailed below.

The work carried out, and proposed future projects are as set out under the following heads.

SECTION II. CANE MOTH BORER.

Diatraea saccharalis, Fabr.

Control of Diatraea by Trichogramma minutum.

The control of the cane moth borer is being attempted by means of the mass rearing and liberation of the Chalcid parasite *Trichogramma minutum,* Riley. The method employed will be outlined later. The objective briefly stated, is to rear and distribute throughout the Island millions of the parasites months before they would normally appear at all in the canefields, and by maintaining a continuous supply, eventually to control the main *Diatraea* broods by destroying their eggs.

Whilst the work of building the necessary breeding rooms, insectary, etc., was in progress, a systematic examination of the prevalence of *Diatraea* in the canefields was made. Fields were examined in every parish in the Island and collections made of all egg masses of Diatraea found. The number of eggs was then counted, and the proportion of parasitized to unparasitized eggs worked out: as the collections were always made by the same workers and to a standard unit of time, the figures obtained should be a fair index of the prevalence of the moth, and the extent of the natural work of *Trichogramma* from month to month. Corresponding figures obtained in other years should show the effect of control measures. At the same time, search was made for the introduced larval parasites, *Ipobracon* and *Microdus* as described later.

In the mean time, preparations had been completed for the mass breeding of *Trichogramma* on the lines discovered by S. Flanders of California, and applied to sugar cane moth borer by Hinds and Spencer in Louisiana.

A double roomed, ant proof building was erected for the rearing of *Sitotroga cerealella* moths, in the eggs of which *Trichogramma* can be bred. A smaller ant proof insectary was also built for the mass rearing of the parasites. Later on, a cold storage box was constructed to hold over the parasites for regular weekly distributions.

As there were no adequate sources for obtaining *Sitotroga* in Barbados, the United States Bureau of Entomology at Washington was approached, and due to their courtesy, ample supplies of *Sitotroga* eggs were obtained.

The moths which were subsequently bred up were collected by means of a vacuum apparatus worked by an engine in a neighbouring building.

In the eggs obtained from these moths, *Trichogramma* were reared in the insectary, and a means devised of checking up fairly accurately the daily output of parasites, and of rendering their simultaneous distribution in the canefields a comparatively easy matter.

The Louisiana Experimental Station was also approached to supply this Department with their strain of *Trichogramma minutum*. It was fortunate that this was done for some difficulty was experienced at first in getting the local strain to ovipesit in *Sitotroga* eggs and even when a working strain was obtained it was not so satisfactory as that subsequently obtained from Louisiana.

The thanks of the Department are due to Dr. Spencer of Louisiana for the trouble taken in despatching colonies by air mail to New York and thence in cold storage on board ship to Barbados.

These colonies are now well established and a minimum output of two million parasites a month is being maintained; this, it is hoped to increase later.

Their distribution needs the co-operation of the Planters, but the scheme at present in operation makes the distribution of the parasites regular and effective, if the said co-operation is forthcoming. It cannot be too strongly emphasized that the work of this section of the Department can never yield its full results and fulfil the end for which it was brought into being, unless the Planters carry out the recommendations and instructions given to them.

With regard to the regular distribution of parasites, it is essential to maintain this month after month; but it must be recognised that in the early months, the majority of parasites will of necessity die owing to the absence of sufficient borer eggs in the field, though borers are present in the young canes.

Later on, however, the continual distribution of parasites should ensure the overwhelming of the main broods of the borer which are the source of the considerable damage which *Diatraea* undoubtedly causes. This damage can be safely estimated at 20—25% of the entire crop over the major portion of the Island. The method of arriving at this estimate is detailed later.

Though it will not be possible to eliminate this pest entirely, it is hoped to secure a noticeable control this year by means of the above campaign, and by similar, but larger liberations of *Trichogramma* in following years, to still further complete the control.

It is also hoped to obtain and introduce larval and pupal parasites from other regions and so to attack the pest in all its stages.

Previously Introduced Parasites.

In 1926-27, the larval parasites *Ipobracon grenadenis*, Ashm and *Microdus* sp. were introduced into Barbados through the assistance of Mr. H. E. Box, and it is recorded that for several months they could still be found in the field. From September onwards in 1928, a close watch was kept on all Cordia bushes planted out for the provision of food supplies for these parasites, and numerous samples of bored cane were taken from various plantations all over the Island. From observation, and from collection of insects by nets at *Cordia* bushes, none of the parasites were either seen or caught. From the numerous bored canes collected, moth borers only, and no parasites, were bred out. During a period of eight months observation, no parasites have been seen or bred out, and it is therefore concluded that they failed to become permanently established on the Island.

Light Traps for Diatraea.

It has been the custom in past years to run traps at Codrington consisting of electric light bulbs suspended above shallow trays of water, bearing a film of paraffin. These traps were placed in the enclosures wherein cane seedlings are reared prior to being established in special fields.

An examination of the insects thus caught was undertaken and records made of the insects attracted and of the numbers of *Diatraea* caught. The latter were dissected and records made of the proportion of females full of eggs, of females which had obviously laid most of their eggs, and of males.

From these records it was concluded that for the protection of small, special areas of young canes, the use of light traps was justified.

Experiments were also made using various chemical attractants at the lights, and it is planned next season to try the effect of coloured lights in attracting the moth borers.

It is probable that another species, besides *D. saccharalis* is present in Barbados.

Estimate of Loss Due to Diatraea.

In order to provide a check on the results of control measures, and to obtain some idea of the actual loss due to the work of moth borers, a series of investigations were undertaken, and loss estimated to cane both in the field and as delivered in the factory yards.

The experiments are too lengthy to be detailed here, and would, moreover, need to be repeated over more than one season, which has naturally not been possible.

Sufficient data was obtained, however, to warrant the statement that an average loss of 20% weight of cane in the field, and from 5—10% weight of that delivered in the factory yard, is caused by moth borer over the major portion of the Island. Further loss is also probably caused during milling operations due to impure juice.

SECTION III. CANE ROOT BORER.

Diaprepes abbreviatus, Linn.

It has not been possible during the time as yet spent in the Island to make any extensive field studies on this pest. Certain experiments have been carried out on a small scale to test the effect of soil fumigants such as paradichlorobenzine and carbon bisulphide on stools in fields badly affected by borer; and it was concluded from results obtained that the soil and moisture conditions, so far as examined here, are not suited to the use of soil fumigants. Apart from the risk to the cane itself, the process would be too expensive and laborious for most Planters.

Examination of badly infected stools revealed that as many as 96 *Diaprepes* larvae and 4 *Phytalus* (*Lachnosterna*) larvae were present in a single hole. In some areas very extensive damage was being done. It was obvious therefore that it was essential to put into effect some control measures against this pest; it was fatal for Planters, at the prevailing low price of sugar, to go on losing several tons of cane an acre from the combined attack of insects.

Past records showed that the life history of *Diaprepes abbreviatus* had been well worked in Barbados; that the damage it was doing was recognized (experienced Planters estimated it at 5 tons of cane an acre in infected areas); that the pest was slowly increasing and spreading, and that sound advice, the appiontment of a Commission, and the issuing of warnings of possible recourse to legislation, had failed to secure uniform and sustained measures against the pest.

It was felt to be essential that immediate steps should be taken to control the root borer beetle simultaneously with the moth borer, and it was planned to do the work departmentally aided by lantern lectures designed to arouse a sense of self help and co-operation in the work.

This scheme did not materialise in its entirety. In place of it, the Planters and peasant community are being urged to combine and put into effect beetle collecting and other measures against the pest. The Department is endeavouring to organize Planters in infected areas into solid blocks of estates pledged to collect the adult beetles and to destroy egg masses and grubs where possible.

At the same time, lantern lectures are being given to illustrate cane pests and the damage they do, and to press home the measures to be carried out, and the material advantage of co-operation in carrying out these measures.

It is hoped thereby to stimulate and carry through successfully an organized campaign against the root borer beetle.

The main measure recommended, namely, the intensive collecting of the adults during the period of their emergence from the soil has every chance of success in an Island of limited area, where there is no possibility of re-infestation or migration back from outside sources.

SECTION IV. FOOD HABITS OF DR. MORRIS BIRD

Tyrannus dominicensis vorax.

Owing to the conviction that this bird was a source of danger due to its feeding on *Tiphia paralella*, Smith, a parasite of the brown hardback, *Phytalus smithi*, Arrow, and that it was in general a menace to agriculture, an investigation into the food habits of a number of those birds was undertaken.

Altogether 95 birds were received from various parts of the Island, and the contents of the crops examined and the insects identified and listed.

All that can be said at present is that only one *Tiphia* was found, and that the majority of the insects identified were pest insects such as *Metamasius sericeus*, Oliv. (Cane Weevil), *Diaprepes abbreviatus*, Linn. (Root Borer), Locusts, and various Hemiptera, etc. Others were doubtful pests, but certainly not beneficial insects. Undoubtedly bees and wasps are eaten in quantities whenever found, but whether the extermination of wasps removes any control from cane or other insect pests, cannot at present be determined. Berries and wild fruits also formed a considerable portion of the birds diet: the remains of young frogs or lizards were also found.

Evidence therefore does not so far condemn the bird, save in the matter of destroying honey bees and lizards etc.; on the other hand it is somewhat doubtful whether its activities are absolutely beneficial, and further work will have to be carried out before any definite verdict can be given.

SECTION V. DESTRUCTION OF MONGOOSE.

There is, however, no doubt whatever that the introduced mongoose should be rigorously suppressed. The destruction which it has caused and is causing to known beneficial birds and to cane and ground lizards, frogs, etc. is having a serious effect on the control which these creatures would otherwise exert on insect pests. It is suggested that an active campaign be started against the mongoose, and a larger bounty offered for its destruction than at present exists.

SECTION VI. PINK BOLLWORM

Pectinophora gossypiella, Saund.

The measures for effectively controlling this pest are largely ones of disinfecting imported seed, and of cultivation and sanitation methods in the field enforced by legislation. Progress on these lines was already being made prior to my arrival and two Simon's Heaters for disinfecting seed imported by cotton oil factories had already been ordered, and legislation relative to close seasons, field sanitation, etc., enacted.

Amendments to and amplification of legislation were found to be necessary, and the close season and time of planting cotton were revised. Arrangements were made for Departmental supervision of the disinfection of seed, and for the adequate fumigation of vessels which had brought seed to the Island.

No other cargo save cotton seed is allowed; disinfection of the seed takes place 200 yards from the shore in an off shore wind, and vessels are fumigated with hydrocyanic acid gas before proceeding to the wharf to take other cargo.

Vessels likely to bring seed to the Island are inspected prior to leaving, to ensure that they are suitable for corrrect fumigation when empty of seed.

Cultivation and field sanitation measures have not as yet been put into operation and cannot start until the end of the first crop planted at the end of the close season. The combined measures laid down for the control of the pink bollworm should eventually make the growing of cotton in Barbados safe so far as pink bollworm is concerned, and should prevent the introduction of Mexican Boll Weevil and of cotton stainers, neither of which as far as is known are present in Barbados.

Parasites of Pink Bollworm.

Enquiries were made through the Imperial Bureau of Entomology, relative to the possibility of obtaining the parasite *Microbracon kirkpatrick*, Wilk. which exerts an appreciable control over pink bollworm in Kenya. The Imperial Bureau succeeded in obtaining a consignment, which was forwarded

through the Parasite Laboratory at Farnham Royal. The parasites were received here about the middle of May, and of the 93 sent, 31 arrived alive. Of these 16 were females and 15 males.

Unfortunately, they arrived in the middle of the close season for cotton in Barbados, and all cotton, both wild and cultivated, had been rigorously cleared up. Some bolls were, however, obtained from experimental cotton grown in insect proof enclosures, and pink bollworms were obtained from the holds of vessels then discharging cotton seed.

The bolls were prepared and submitted to the parasites according to instructions given, but at the time of writing it does not appear that the parasites have worked at all. It is hoped, however, that other consignments may be obtained early in 1930 when plentiful material in which to rear them should be available.

SECTION VII. SUBSIDIARY INSECT PESTS.

A certain amount of time was at first given to the study of ants, and to carrying out experiments for obtaining safe and easily applicable methods of control over the more troublesome species. Four species of ants were involved, known locally as acrobat ant, stinging ant, small red ant, and crazy ant. A certain amount of information was obtained, but the press of other work and difficulty in obtaining chemicals required precluded any results being obtained. This work will, however, be taken up in the future.

Other pests needing attention are corn ear worm, scale insects and cockroaches and such time as is possible will be given to them when the control of major insect pests is more completely under ~~weigh~~ wea[illegible].

SECTION VIII. INSECT COLLECTION.

The Departmental collection of insects was cleaned and overhauled and damaged specimens removed or replaced and fresh preservatives added. A complete list of insects identified from Barbados was also compiled from scattered records. A few unidentified insects have been collected but it has not been possible to devote much time to collecting or preparing insects for cabinets or for identification.

Chapter VI.

REPORT OF THE PLANT DISEASES INSPECTOR FOR THE YEAR 1928—29.

(D. R. D. WILES, D.I.C.T.A.).

SECTION I. SUGAR CANE MOSAIC DISEASE.

The inspection of cane for the mosaic disease was continued throughout the Island until the fields became impassable. The statutory period for compelling owners and occupiers of land to remove diseased canes expired at the end of August. After this period, however, at the request of the Inspectors, diseased canes were still removed.

During the tours of inspection it was found that Indian corn, Guinea corn and Imphee growing in the proclaimed infected areas (vide Annual Report, Department of Agriculture, 1927—28) were suffering from mosaic disease and, secreted at the base of the inner leaves, *Aphis maidis* the insect vector of the mosaic disease, was always found. Gowdey working in Jamaica proved that the Corn Leafhopper, *Peregrinus maidis,* which is also present on corn in Barbados, transmits mosaic disease from corn to corn but not from corn to cane. The above facts as well as the continued and persistent presence of the mosaic disease in certain cane growing areas made it advisable tat a close season for corn be provided for in those areas. The Mosaic Disease Eradication Act was therefore amended to enable this to be done, and by a Proclamation issued on the first day of July, 1928, a close season for corn was ordered from 1st December, 1928, until the 31st of March, 1929, inclusive.

The areas in which the planting or growing of corn was prohibited were identical with the proclaimed infected areas mentioned in the Report of 1927-28 and the additional areas proclaimed as infected areas during 1928. These areas are as follows:—

Parish of Christ Church.

All that area bounded on the North by Wotton plantation, Kingsland plantation and Maynards plantation, on the East by the Lodge Road, on the South by Top Rock, on the West by Graeme Hall plantation and Wotton plantation.

All that area bounded on the North by Top Rock Road on the East by the road leading from Top Rock Road passing Christ Church parish Church to the bottom of Thornbury Hill and the road leading from the bottom of Thornbury Hill to the Oistin's Main Road, and by a line due South from the point where the latter roads meet to the Sea, on the South by the Sea, on the West by the Eastern boundary of Graeme Hall plantation to the top of Top Rock Hill, Top Rock Hill and a line due South from the point where Top Rock Hill enters the St. Lawrence-Maxwell's Road to the Sea.

All that area included in Pilgrim Tenantry, Coverley Tenantry and Charnocks Tenantry.

The effect of this close season for corn will probably not become noticeable until much later in the year when very beneficial results are expected. It is hoped that by this means the percentage infection in the proclaimed areas will be considerably lessened.

Parish of St. Michael.

All that area included in Lower Estate plantation.

Parish of St. Thomas.

All that area included in Rock Hall Tenantry and Barnwell plantation.

All that area included in Edgehill plantation.

Advertisements were again placed this year in the daily newspapers inviting managers and occupiers of land outside the proclaimed infected areas to have canes, from which they desired to cut plants, inspected for mosaic disease.

Many planters took advantage of this with the result that there is very little mosaic disease, if any, present on those places which have been inspected. The attention paid to this inspection for cutting of plants cannot be too fully emphasized as on this depends to a very large extent the amount of mosaic disease which will be present in the young crop. Each diseased stool cut for plants will give rise to about forty or fifty diseased stools in the young crop.

Cane plants were again supplied on application to holders of land in the proclaimed infected areas. Applications were made on the usual forms and certificates of approval issued. There was a slight change in the price of the plants, every applicant paying for plants according to the area of land he occupied. Owners or occupiers of land of less than one acre paid 3d. per 100, owners or occupiers of land between one and five acres 6d. per 100, and owners or occupiers of land of more than five acres 1/- per 100.

Cane plants were distributed from the following places to the different infected areas:—

St. Michael.	Lears and Waterford plantations.
St. James.	Molyneux plantation.
St. Peter.	Warleigh plantation.
St. Lucy.	Colleton plantation and from healthy fields in the proclaimed area.
Christ Church.	Coverley plantation and from healthy fields on the named plantation. Plants were cut under the supervision of an Inspector.

The plants were obtained from fields on the different estates which were free from infection during the general inspection from April to August last year. These fields were re-inspected immediately before cutting for plants.

The inspection of the young crop commenced in mid-January, 1929, and is being continued throughout the year until the canes become impassable.

Parish of St. Michael.

Special mention must be made of Bay Estate, Prout's Tenantry and My Lord's Hill Tenantry, (the latter includes the Belle Plantation Tenantry) where mosaic disease is scarcely to be found at present. In the other parts of the infected areas there is a marked improvement, but the disease is always present in the ratoons while the plant canes are fairly free from infection.

Parish of St. James.

The infection in the proclaimed infected areas continued to be on the decline. The supply of healthy plants has, no doubt, assisted in this measure.

Parish of St. Peter.

The infection in the proclaimed infected area is on the decline, but, although favourable results have been obtained in this district, a fair amount of the disease still persists. It is, however, mainly confined to ratoons. On account of the large number of quarter and one-eighth acre plots the control of the disease in this district is rendered very difficult.

Parish of St. Lucy.

The improvement in the Checker Hall district has been excellent. Only one applicant was compelled to purchase plants from the Department, while the others were allowed to cut their own plants after they had been inspected. During the Inspector's first visit only three diseased holes were found in the proclaimed area.

Parish of Christ Church.

The estates in the proclaimed areas in this parish have shown decided improvement.

Several estates and small holdings have been inspected and so far a general improvement has been noted. Special mention must be made of one estate which has been in the infected area for two years and only 37 diseased holes were found in 85 acres; plants were cut on this estate under the personal supervision of an Inspector and the Manager. This shows that proper supervision and inspection of plants during the planting season must be practised for beneficial results to be obtained.

The result of supplying healthy plants to the tenantries in the infected areas has been satisfactory, and the occupiers are beginning to realize the value of systematic inspection and rogueing of their plots. The occupiers are gradually becoming educated to the methods of control and are rendering all assistance to the Inspectors during their visits.

During the year there were 28 convictions under the Mosaic Disease Eradication Act.

FINANCIAL STATEMENT RELATING TO THE WORK OF THE DEPARTMENT PERFORMED UNDER THE MOSAIC DISEASE ERADICATION ACT.

(*a*) Purchase of canes for the distribution of healthy cane plants to applicants in the areas proclaimed to be infected:

Parish of St. Michael	£447	11	4
„ „ Christ Church	45	7	6
„ „ St. James	39	13	9
„ „ St. Peter	21	15	9
„ „ St. Thomas	14	13	9
„ „ St. Lucy		8	0
	£569	10	1

(*b*) Expenditure in connexion with labour for reaping canes, cutting plants, etc.:

Parish of St. Michael	£79	1	7
„ „ Christ Church	5	12	5
„ „ St. James and St. Thomas ..	4	6	0
„ „ St. Peter	2	10	8
	£91	10	8

(*c*) Miscellaneous Expenditure:—

Advertisements, etc.	£10	13	9

SUUMARY OF EXPENDITURE.

Expenditure in Section (a)	£569	10	1
Expenditure in Section (b)	91	10	8
Expenditure in Section (c)	10	13	9
	£671	14	6

RECEIPTS.

Parish of St. Michael	£173	8	5½
„ „ Christ Church	18	10	11
„ „ St. James and St. Thomas ..	13	18	1½
„ „ St. Peter	6	15	6½
„ „ St. Lucy		4	0
	£212	17	0½

A COMPARISON WITH THE PREVIOUS YEAR.

Expenditure	1927—28 ..	£820	8	10
Expenditure	1928—29 ..	£671	14	6
Decrease		£148	14	4
Receipts	1927—28 ..	£145	13	7½
Receipts	1928—29 ..	£212	17	0½
Increase		£ 67	3	5

SECTION II. INSPECTION UNDER THE COTTON DISEASES PREVENTION ACT, 1928.

Under this Act which came into force on the 16th July, 1928, provision was made for the appointment of Sub-Inspectors who were appointed and stationed in the different parishes of the Island.

Instructions were issued to these Inspectors to look for all old cotton plants and any wild cotton plants which may have escaped the general cleaning up, and to have them immediately destroyed by fire.

Many wild and cultivated cotton plants have been found in the tenantries and gullies of the Island and in many instances when there were pods on the trees the pink bollworm was found to be present. These trees have been destroyed by fire.

A systematic search of the pods of the Silk Cotton was carried out from the time the trees commenced to flower until the pods opened. No pink bollworm, however, has so far been discovered in any of the pods which have been examined although the pods were taken from different parts of the Island.

The okra which belongs to the same order (*Malvaceae*) was also examined. Pink bollworm of cotton was found in old okra pods throughout the Island. A Leaflet was immediately issued requesting that all old okra trees be destroyed. This leaflet assisted to a large extent in the destruction of the old okra plants and it is pleasing to state that the owners and occupiers of land willingly assisted in their destruction.

In order to maintain a supply of seed for planting in 1929 several plots of cotton were planted in different parts of the Island. These plots have been reaped. In many cases the amount of seed cotton obtained was below the average owing to the severe attacks of the cotton worm and the pink bollworm; the Department has, however, for distribution later in the year approximately 4,000 lb. of seed for planting purposes throughout the Island.

APPENDIX I.

METEOROLOGICAL OBSERVATIONS

RECORDED AT THE METEOROLOGICAL STATION, CODRINGTON.

Height Above Sea-Level, 181 Feet.

Latitude 13°7′ 36″N. *Longitude 59°35′ 57″W.*

The following are summaries of the observations recorded for the year 1928. The details are given in Appendix II.

Barometric Pressure.—The records refer to observations made at the hours of 9 a.m. and 3 p.m. only. During the year 1928 the mean pressure corrected for temperature and gravity and reduced to sea-level was at 9 a.m. 29.977 and at 3 p.m. 29.901, the highest recorded being 30.088 at 9 a.m. on February 26th and the lowest 29.750 at 3 p.m. on October 29th. For the ten year period 1918—27 the average barometric pressure was at 9 a.m. 29.975 and at 3 p.m. 29.901. The highest pressure during the ten year period was recorded at 9 a.m on January 22, 1925, when it was 30.127 and the lowest at 3 p.m. on September 8, 1921, when it was 29.694.

Temperature.—The daily mean maximum temperature for the year 1928 was 85.4°F. and the daily mean minimum 72.9°F. The maximum extreme for the year which was 89.1°F. was registered on May 13 and the minimum extreme which was 64.2°F. was registered on February 11th. The average daily mean temperature was 79.2°F., the highest monthly range 22.4°F., and the lowest 15.9°F., the mean monthly range being 18.1°F. For the ten year period 1918—27 the daily mean maximum temperature was 85.2°F., and the daily mean minimum 72.6°F. During the ten year period the average daily mean temperature was 78.9°F., the maximum extreme was 91.5°F on August 23rd, 1927, the minimum extreme 63.0°F. on January 25, 1919 and the average monthly range 18.4°F.

Tension of Vapour and Relative Humidity.—The mean tension of vapour for the year 1928 was at 8 a.m. .735 and at 5 p.m. .714. The mean relative humidity was at 8 a.m. 72.1 and at 5 p.m. 70.2.

Wind.—The daily (24-hour period) mean velocity of the wind during the year 1928 was 9.2 miles an hour. Records were kept of half daily or 12-hour periods from 6 a.m. to 6 p.m. and 6 p.m. to 6 a.m. The maximum velocity for any such 12-hour period was 22.2 miles an hour, recorded between 6 a.m. and 6 p.m. on June 23, and the minimum velocity was 1.7 miles an hour, recorded between 6 p.m. and 6 a.m. on April 19.

Rainfall.—The rainfall measured at the Government Meteorological Station during the year 1928 amounted to 56.18 inches. This fell on 233 days, the greatest fall being 6.00 inches on November 9. For the ten year period 1918—27 the average annual rainfall was 43.13 inches and the average number of days annually on which rin fell ws 173.

Rainfall of the Island.—The total mean rainfall for the year 1928 from 141 stations was 57.21 inches, being 3.32 inches below the average for the sixty years ended December 31, 1927, which was 60.53 inches.

The accompanying Chart, comparing the monthly rainfall of 1928 with the average monthly rainfall for the ten-year period 1918—27, demonstrates the uneven distribution of the rainfall during the year. An abnormal amount of rain fell in the month of November, resulting in the highest total rainfall for the month of November recorded since 1896.

BARBADOS RAINFALL.

CHART COMPARING AVERAGE RAINFALL FOR TEN YEARS 1918-27 WITH RAINFALL FOR YEAR 1928

APPENDIX

RAINFALL AT SELECT SEEDLING STATIONS FROM DECEMBER 1927 TO MARCH 1929.

Station.	Height above Sea level in feet	December 1927		January 1928		February		March		April		May		June		July.		August		September.		October.		November		December.		January 1929.		February.		March.		Total.	
		Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.
Coverley ..	254	12	4·23	18	3·38	9	1·39	7	2·14	5	·91	6	·73	12	4·32	12	4·59	11	5·13	9	1·72	14	5·09	15	14·57	9	4·80	9	2·88	12	1·71	7	·53	167	58·72
Graeme Hill ...		10	3·92	15	2·80	10	1·17	7	1·81	6	·55	4	·38	14	3·81	12	3·61	12	6·15	13	2·21	15	7·79	18	16·81	13	4·21	10	1·22	12	1·43	6	·22	177	58·09
Hannays	183	16	3·70	12	2·15	12	1·60	9	1·90	5	·66	1	·15	10	3·36	13	5·65	11	5·01	9	2·35	12	9·85	17	15·87	11	6·10	11	1·75	11	1·65	4	·69	167	62·41
Carrington .	110	16	4·42	19	3·50	14	1·51	14	2·22	8	·75	7	·64	17	3·15	19	5·17	10	4·87	10	2·78	20	11·64	19	14·84	9	4·02	12	1·29	12	1·70	6	·44	212	63·21
Sunbury ..	.	13	3·82	22	2·99	10	1·03	15	1·95	7	·70	6	·66	15	1·88	18	5·33	15	5·20	13	3·63	19	11·70	18	17·39	12	3·85	10	1·12	10	1·35	6	·27	210	62·82
Brighton .	71	14	5·33	21	5·13	8	1·53	11	2·31	7	1·03	3	·22	16	3·12	17	6·52	11	6·11	10	2·58	19	11·20	17	15·75	9	3·97	11	1·91	6	1·14	5	·71	188	66·86
Waterford .	181	11	3·50	22	2·48	9	·85	13	1·38	5	·43	2	·10	9	2·81	17	4·56	13	8·12	12	3·52	16	7·58	19	17·38	15	3·18	17	2·06	10	·75	6	·31	196	59·01
Sandy Lane ..	...	13	3·22	25	3·72	12	1·41	11	1·43	3	·25	3	·22	9	3·82	18	5·30	16	11·09	13	3·81	19	7·79	20	15·10	13	4·32	15	1·69	16	1·89	6	·62	208	65·53
Warleigh ..		10	3·58	19	4·78	6	2·74	13	4·11	5	·81	4	·38	9	2·84	19	7·19	16	9·05	14	4·57	18	9·13	18	13·47	14	5·41	10	1·47	17	3·38	8	1·04	200	71·64
Pickerings ..	71	12	3·48	20	4·89	11	2·33	16	2·87	8	·99	3	·13	9	3·31	17	5·18	15	7·03	18	5·20	18	12·11	15	11·17	11	2·55	7	·42	11	2·30	9	·69	203	61·65
Lears .	...	16	5·39	28	5·27	15	1·90	13	3·01	6	·87	4	·39	15	4·69	13	6·49	11	7·31	8	5·57	17	12·89	14	9·76	23	5·94	15	2·45	18	2·19	9	1·33	225	74·95
Ridgeway .	.	7	3·36	16	4·78	8	2·11	8	1·31	3	·37	3	·38	10	4·15	15	5·99	15	10·12	15	4·90	15	8·72	18	15·75	8	4·93	8	2·55	9	3·11	4	1·29	162	73·82
Lemon Arbor ...	720	9	4·48	18	4·74	12	2·48	11	2·25	3	·69	3	1·11	12	4·20	12	6·19	16	8·91	12	5·14	17	11·95	20	18·49	16	4·51	10	1·93	12	2·06	5	·89	188	80·09
Vaucluse ...	731	15	5·72	26	5·67	13	1·90	12	1·72	6	·59	3	·36	12	3·72	21	5·99	17	10·25	16	5·62	17	9·55	20	17·85	16	4·17	13	1·41	15	2·09	6	·64	228	76·65
Blackmans ..	...	18	6·70	25	6·03	12	2·20	15	3·68	5	1·23	5	·98	13	4·55	18	7·80	18	9·62	15	4·95	23	11·18	23	19·63	15	5·40	16	2·67	16	3·18	...	...	...	...
Buckden ..	.	12	5·54	21	4·87	12	2·25	13	3·04	9	1·37	9	1·00	14	5·88	17	7·96	18	8·85	17	4·54	19	11·72	15	17·81	16	5·55	12	1·76	12	2·91	8	1·31	224	84·36
Lion Castle ..	..	20	5·51	26	6·46	19	2·18	17	2·84	16	1·50	12	·88	18	4·75	23	8·27	18	12·13	26	6·00	21	11·76	22	19·72	20	4·52	22	2·06	22	4·06	14	1·51	313	94·15
Mount Wilton .	.	15	4·22	23	5·13	13	2·30	18	2·77	10	1·40	13	·90	14	3·73	21	6·03	21	9·48	18	4·23	22	8·62	18	15·15	21	3·89	21	1·41	17	2·61	9	1·09	274	72·96

APPENDIX II.

METEOROLOGICAL REPORT FOR 1928.

DEPARTMENT OF AGRICULTURE, BARBADOS.

Height above Sea Level 181 *Feet.*

Months.	Parometic Pressure reduced to 32° Fabrenheit, Latitude 13° 7′ N., mean Sea-level, and corrected for gravity.					Temperatures °F.									Tension of Vapour.			Relative Humidity.			Wind.	Rainfall	No. of days on which rain fell
	9 a.m.	3 p.m.	Mean.	Highest.	Lowest.	Maximum Mean	Minimum Mean	Maximum Extreme	Minimum Extreme	Maximum blackened bulb 4 ft from ground in vacuo	Mean for Month	Range for Month	Dew Point 8 a.m.	Dew Point 5 p.m.	8 a.m.	5 p.m.	Mean	8 a.m.	5 p.m.	Mean	Velocity, miles per hour		
January ..	29 980	29 898	29.939	30.069	29.862	83.3	71.2	84 4	67.4	143.7	77.3	17.0	68.6	67.5	.702	.676	.689	77.5	72.1	74.8	9.8	2.40	27
February ...	30.025	29.941	29 983	30.088	29.853	84.7	71.1	86.6	64.2	148.3	77.9	22.4	66.2	65.7	.644	.633	.639	67.8	64.4	66.1	10.5	1.07	12
March ...	30.021	29.923	29 972	30.068	29.881	84.9	71.0	87.2	66.4	149.3	78.0	20.8	67.0	65.6	.665	.636	.651	68.9	64.1	66.5	9.3	2.00	18
April ...	29.997	29.916	29.956	30.079	29.851	86.5	72.7	88.6	69.6	147.7	78.6	19.0	66 8	66.1	.658	.642	.650	63.5	62.5	63.0	10.0	.54	11
May ...	29.994	29.924	29.959	30.034	29.844	87 6	74.6	89.1	71.9	155.5	81.1	17.2	67.6	67.3	.678	.672	.675	62.1	61.8	61.9	9.9	.27	10
June ...	29.976	29.907	29.941	30.046	29.858	87.2	74.9	89.0	71.8	146.3	82.2	17.2	69.9	68.8	.734	.706	.720	68.1	64.7	66.4	13.6	3.20	16
July ...	30.008	29.945	29.977	30.074	29.897	85.4	74.8	87.8	71.9	145.5	80.1	15.9	71.2	70.7	.768	.750	.759	73.4	71.2	72.3	11.6	5.92	22
August ..	29.974	29.915	29.944	30.024	29.852	85 5	73.4	87.9	71.8	148.3	79.5	16.1	72.4	71.1	.801	.765	.783	74.8	71 9	73.4	6.5	7.91	20
September ...	29.948	29.870	29.909	30.036	29.774	86.4	74.1	88.2	71.3	150.6	80.3	16.9	72.8	72.2	.811	.793	.802	74.7	74.3	74.5	7.0	5.62	22
October ...	29.936	29.854	29.895	30.001	29.750	85.8	73.1	87.3	69.6	149.9	79.4	17.7	73.7	72.5	.833	.801	.817	78 8	78.1	78.4	6.2	8.03	26
November ...	29.916	29.838	29.877	29 996	29.775	84.8	73 1	87.8	70.0	154.9	78 9	17.8	72.5	72.0	.800	.789	.794	78.6	81.7	80.1	8.3	16.03	24
December ..	29.954	29 875	29.914	30.037	29.788	83.5	70.5	85.6	66.5	144.5	77.0	19.1	69.9	68.9	.730	.711	.720	77.1	75.9	76.5	8.0	3.19	25
	359.729	358.806	359.266	360.552	357.985	1025.6	874.5	1049.5	832.4	1784.5	950.3	217.1	838.6	828.4	8.824	8.574	8.699	865.3	842.7	853.9	110.7	56.18	233
	29.977	29.901	29.939	30.046	29.832	85,4	72.9	87.4	69.4	148.7	79.2	18 1	69.9	69.0	.735	.714	.725	72.1	70.2	71.1	9.2		